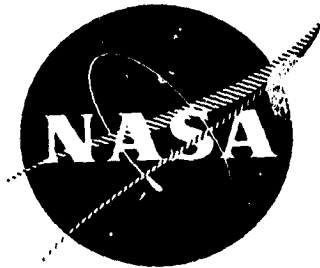


## N O T I C E

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INFORMATION AS POSSIBLE



**Demonstration of Short-Haul Aircraft Aft Noise Reduction  
Techniques on a Twenty Inch (50.8 cm) Diameter Fan  
Volume II**

By  
D. L. Stimpert

— COMPANY

(NASA-CR-134850) DEMONSTRATION OF  
SHORT-HAUL AIRCRAFT AFT NOISE REDUCTION  
TECHNIQUES ON A TWENTY INCH (50.8) DIAMETER  
FAN, VOLUME 2 (General Electric Co.) 307 p  
HC A14/MF A01

N80-15084

Unclas  
CSCL 21E G3/07 33461

prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA-Lewis Research Center  
NAS3-18021

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## DISCUSSION

This volume, the second of three, reports on tests which were conducted to investigate aft fan noise reduction techniques. The test vehicle was a twenty-inch (50.8 cm) diameter fan which had a low tip speed and low pressure ratio.

Tables I and II list the source noise and aft suppression configurations that were tested. From these, selected comparison plots of the 1/3-octave band model data were made. Each series of selected comparison plots has the following:

- PNL vs. acoustic angle at two fan speeds
- PWL vs. frequency at two fan speeds
- SPL vs. frequency at two aft angles and two fan speeds

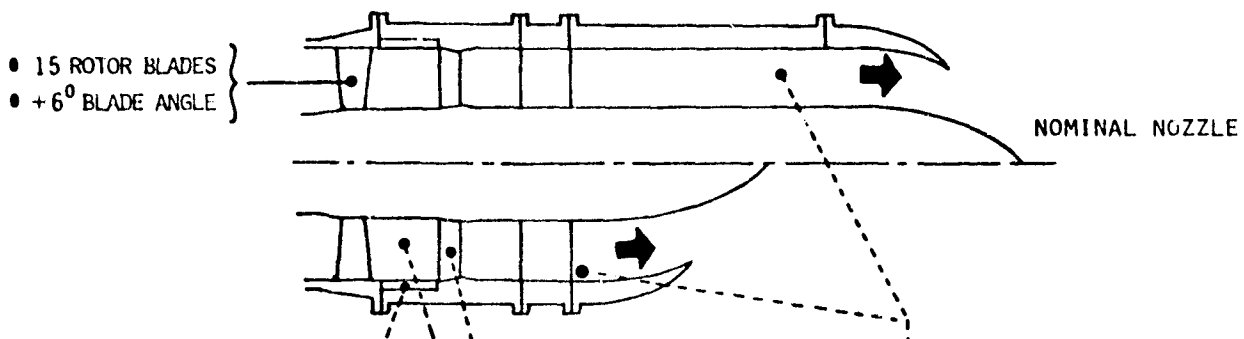
In addition, the source noise comparisons include:

- BPF SPL vs. acoustic angle at two fan speeds
- Second harmonic SPL vs. acoustic angle at two fan speeds

Where it is not confusing, both the original and the repeat data points are shown on the comparison plots. However, where showing both would lead to too many symbols, only the average of the data points is plotted.

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Table 1. Source Noise Test Configurations.



CONFIGURATION	ROTOR-OGV TREATMENT	SPACING	VANE NUMBER	VANE/BLADE RATIO	DUCT LENGTH	COMMENTS
1B	NO	1.5	11	0.73	LONG	STAGE 55 VANES
2	YES	1.5	28	1.87	SHORT	BASELINE VANES
3A	↓	1.5	31	2.07	↓	BASELINE VANES
4B	↓	1.5	31	2.07	↓	LOW MACH VANES
5	↓	1.0	28	1.87	↓	BASELINE VANES
6	↓	1.5	28	1.87	LONG	↓
12	↓	1.5	26	1.73	SHORT	↓
13	↓	1.5	27	1.80	↓	↓
14A	↓	2.0	28	1.87	↓	↓
18	NO	1.5	28	1.87	LONG	↓
19	YES	1.5	25	1.67	SHORT	↓
20	↓	1.5	29	1.93	↓	↓
21	↓	1.5	30	2.00	↓	↓
22	↓	1.5	28	1.87	↓	(REPEAT OF CONFIG. 2)
27	NO	0.5	31	2.07	↓	↓
28	↓	↓	30	2.00	↓	↓
29	↓	↓	29	1.93	↓	↓
30	↓	↓	28	1.87	↓	↓
31	↓	↓	27	1.80	↓	↓
32	↓	↓	26	1.73	↓	↓
33	↓	↓	25	1.67	↓	↓

Table II. Aft Suppression Test Configurations.

1.5 CHORD SPACING 28 BASELINE VANES

• 15 ROTOR BLADES  
• +6° BLADE ANGLE

\*INNER AND OUTER PANELS ARE THE SAME DEPTH AND POROSITY UNLESS OTHERWISE NOTED BY (1) AND (0).  
\*\*R DENOTES AERODYNAMIC RAKES IN FRONT OF THE ROTOR.

CONFIGURATION	ROTOR-OGV TREATMENT	DEPTH POROSITY IN. (CM.)	DEPTH POROSITY %	DEPTH POROSITY IN. (CM.)	DEPTH POROSITY %	DEPTH POROSITY IN. (CM.)	DEPTH POROSITY %	NOZZLE	COMMENTS
6	YES	0	0	0	0	0	0	NOMINAL	
7,7R	NO	.25(.64)	12	.50(1.27)	12	.75(1.91)	12		
8,8R		.25(.64)	27	.50(1.27)	27	.75(1.91)	27		
9,9R		.50(1.27)	27	.25(.64)	27	.75(1.91)	27		
10,10R		.50(1.27)	27	.25(.64)	27	.75(1.91)	27		
16,16R		.25(.64)	27	.50(1.27)	27	.75(1.91)	27		
17		.75(1.91)	27	.75(1.91)	27	.75(1.91)	27		
18,18R		0	0	0	0	0	0		
23		0	0	0	0	0	0		
24		{(0).25(.64) (1).75(1.91)}	27	.50(1.27)	27	.75(1.91)	27		
25		{(0).25(.64) (1).25(.64)}	27	.50(1.27)	27	.75(1.91)	27		
26		1.5(3.81)	12	.75(1.91)	12	.50(1.27)	12		
75-1A		0	0	0	0	0	0		
75-1B									
75-1C									
75-1D									
75-1E									
75-1F									

WITH 0.6 IN. (1.52 CM) SPLITTER, L/H = 2.30

SLANT CELL - LAST OUTER PANEL

SUMMIT CELL

Table II. Aft Suppression Test Configurations (Concluded).

• INNER AND OUTER PANELS ARE THE SAME DEPTH AND POROSITY UNLESS OTHERWISE NOTED BY (I) AND (O).

CONFIGURATION	ROTOR-OGV TREATMENT	DEPTH POROSITY		DEPTH POROSITY		DEPTH POROSITY		DEPTH POROSITY		NOZZLE	COMMENTS
		IN. (CM.)	%	IN. (CM.)	%	IN. (CM.)	%	IN. (CM.)	%		
75-1G	NO	0	0	0	0	0	0	0	0	NOMINAL	
75-1H											
75-1I											
75-1J											
75-1K											
75-2	YES	.25(.64)	12	.50(1.27)	12	.75(1.91)	12	.75(1.91)	12	.25(.64)	27
75-3A	NO	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12
75-4		(O).25(.64)	12	.50(1.27)	12	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12
75-5		(I).75(1.91)	12	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12
75-6A		1.5(3.81)	27	.75(1.91)	12	.50(1.27)	27	.25(.64)	27	.25(.64)	27
75-6B		.75(1.91)	12	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12	.75(1.91)	12
75-6C		0	0	0	0	0	0	0	0	0	0
75-6D		1.5(3.81)	27	0	0	0	0	0	0	0	0
75-7		.25(.64)	12	.75(1.91)	27	.50(1.27)	12	.50(1.27)	12	1.5(3.81)	27
75-8		.50(1.27)	12	.75(1.91)	12	.75(1.91)	12	.25(.64)	12	1.5(3.81)	27
75-9		.25(.64)	12	.50(1.27)	12	.75(1.91)	12	.75(1.91)	12	1.5(3.81)	12

STAGE 55 VANES

TREATMENT L/H = 3.68

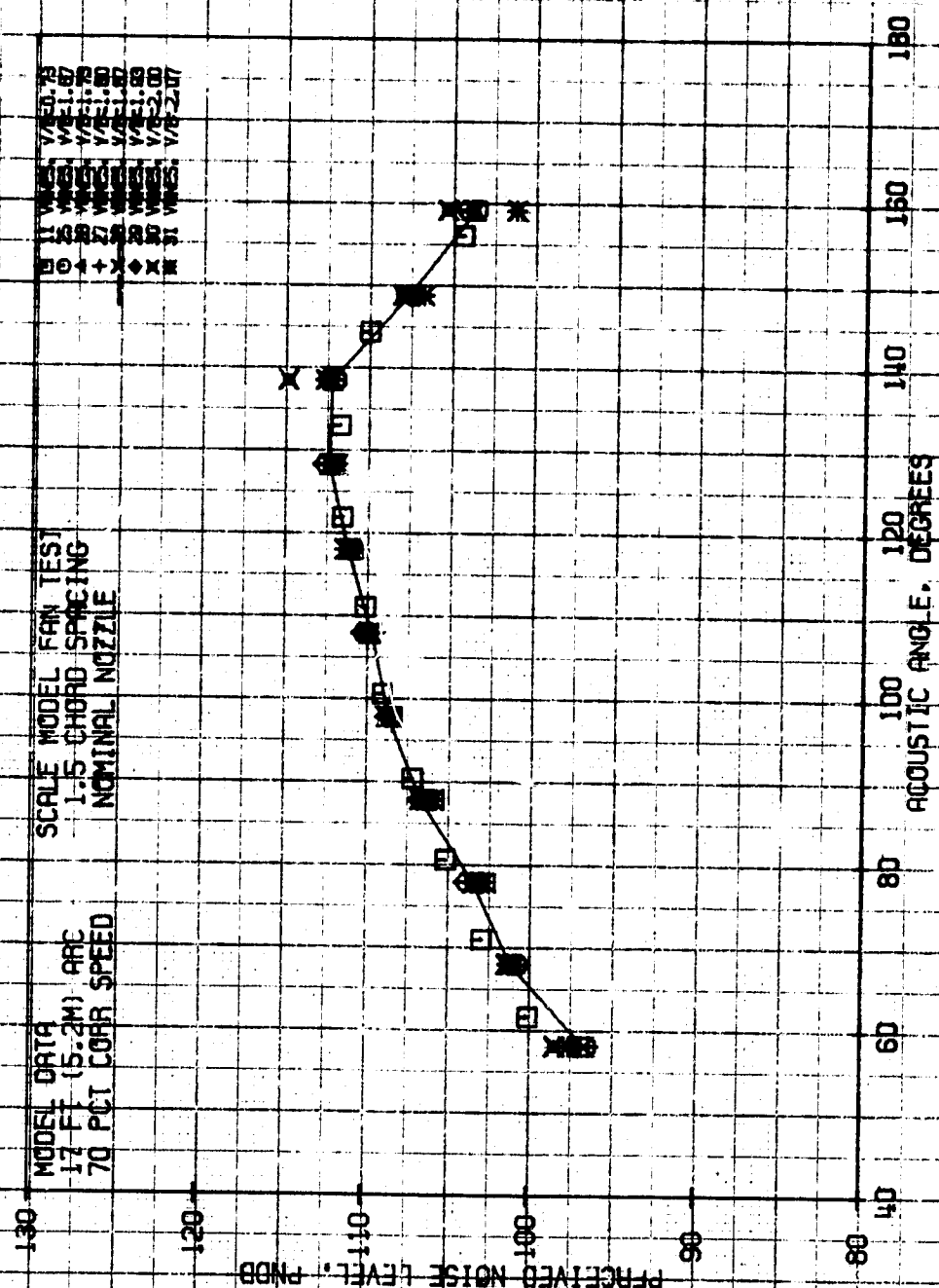


FIGURE 1

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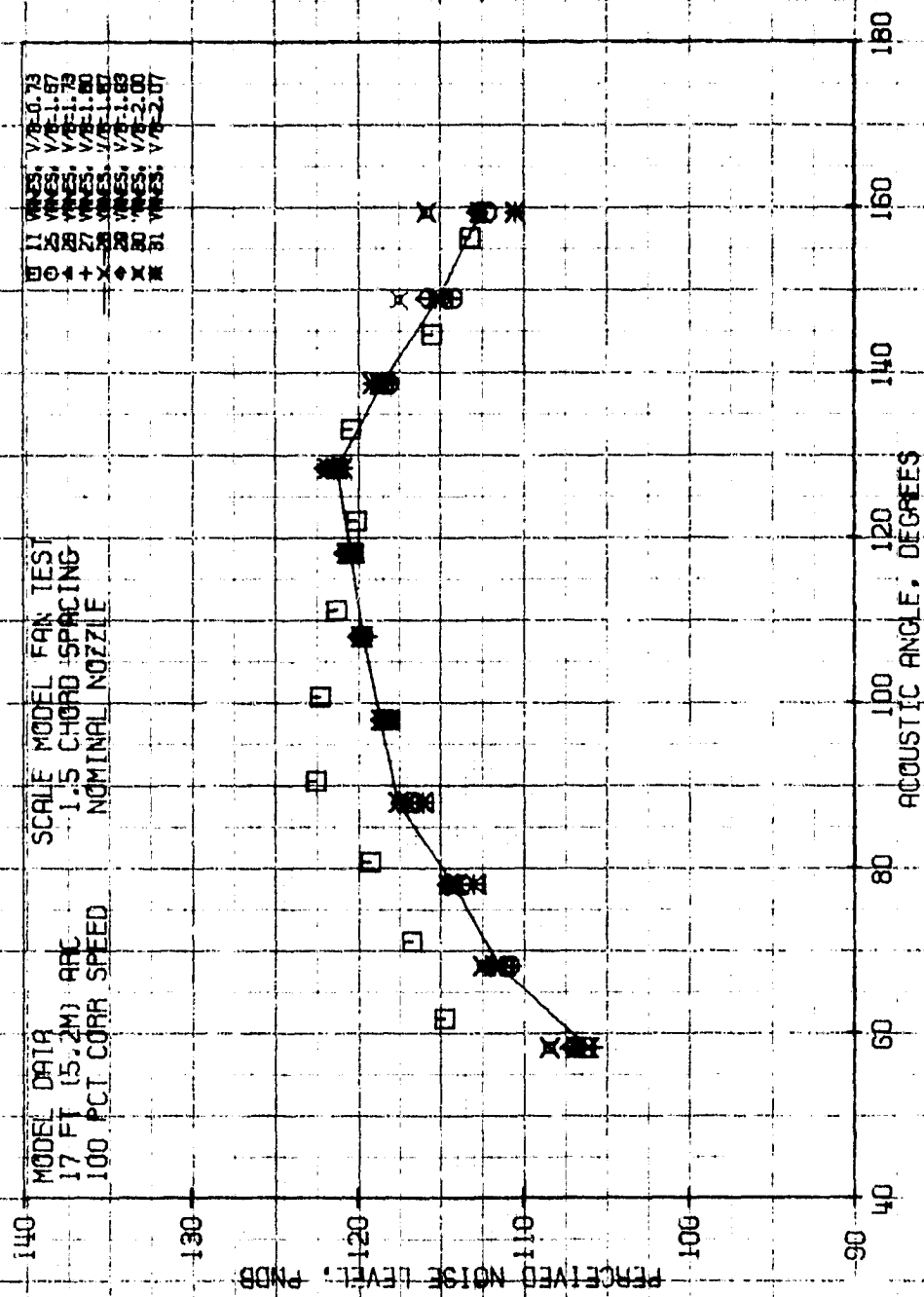


FIGURE 2

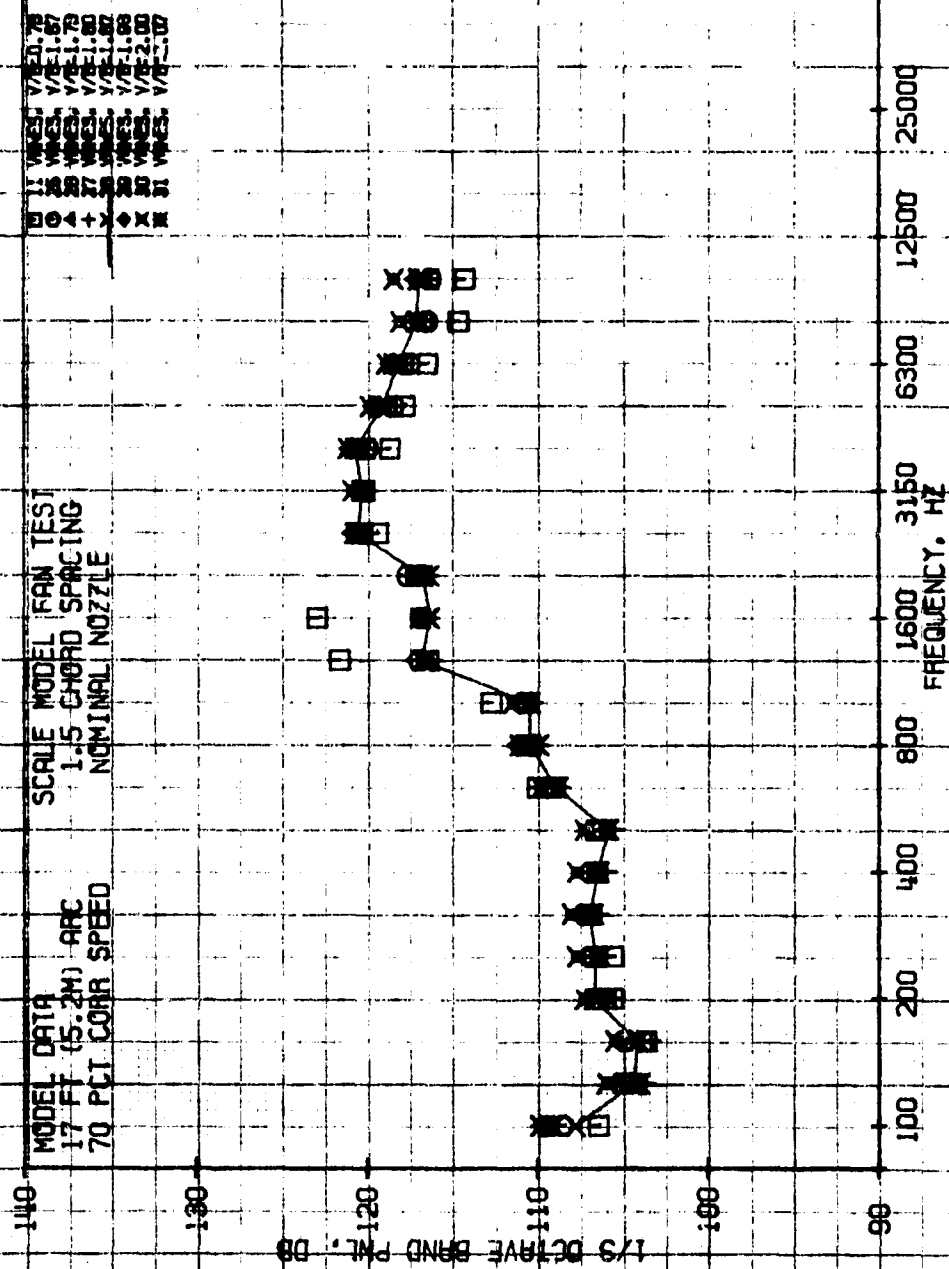


FIGURE 3

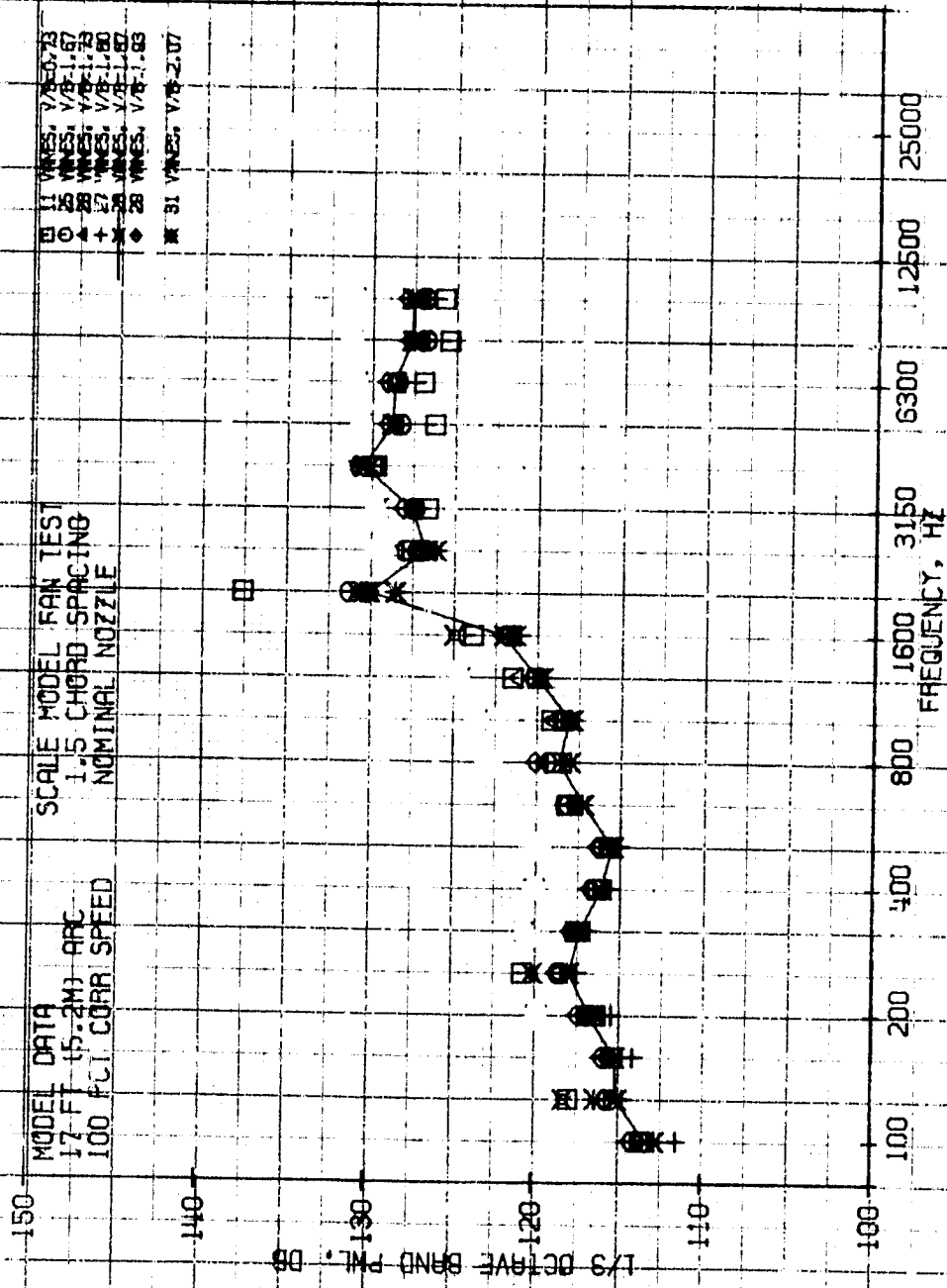


FIGURE 4

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OF POOR QUALITY



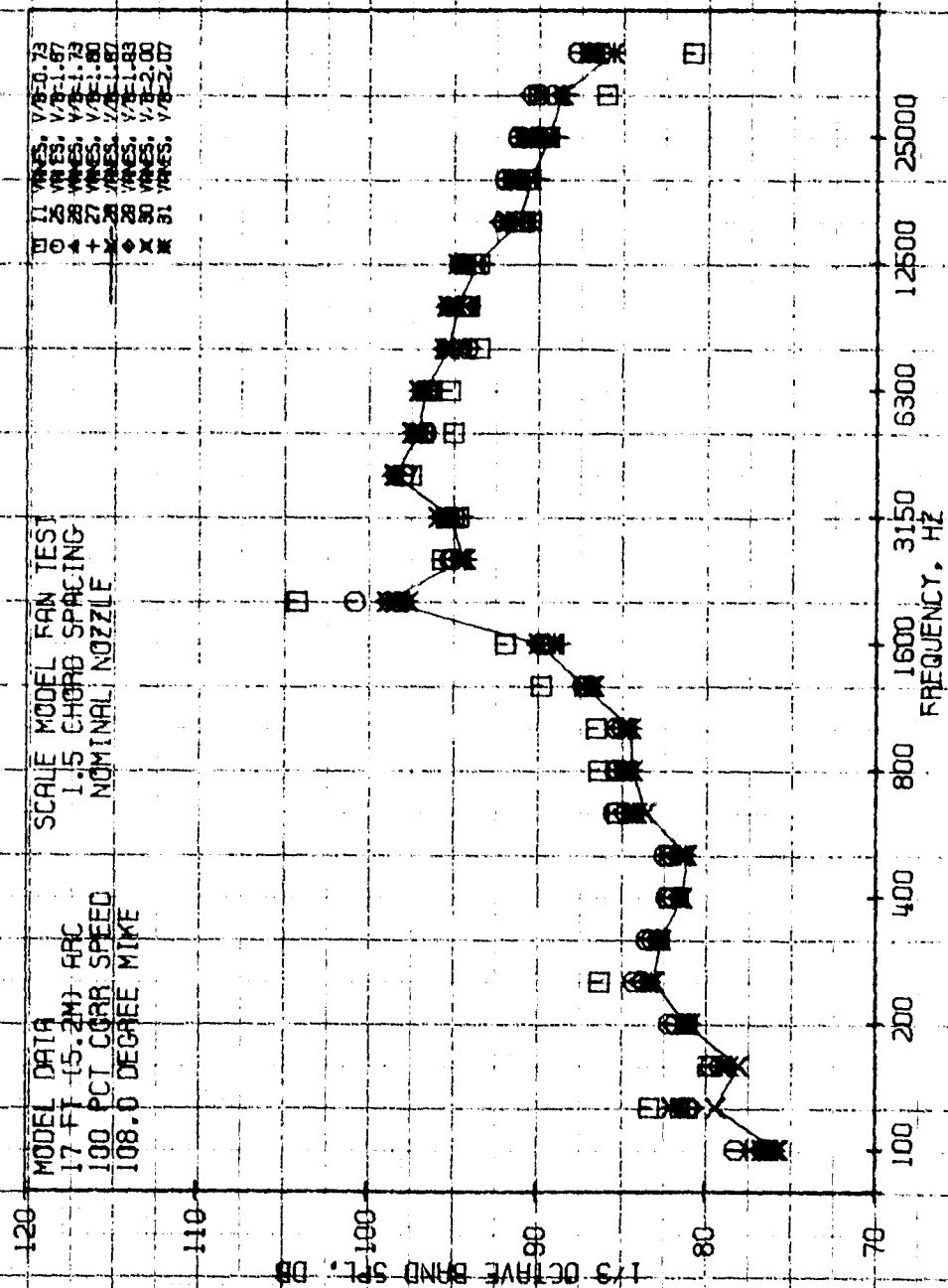


FIGURE 6

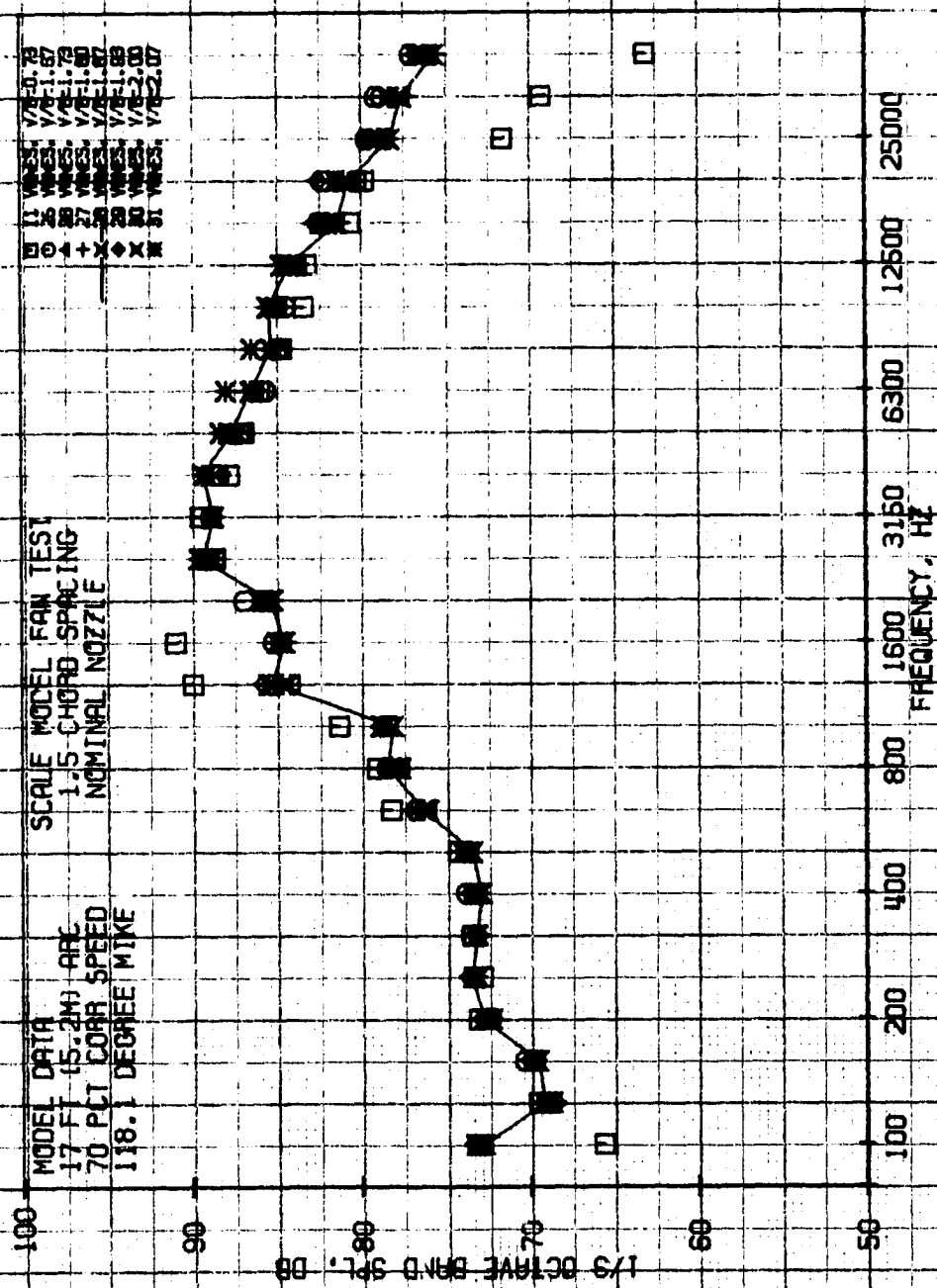


FIGURE 7

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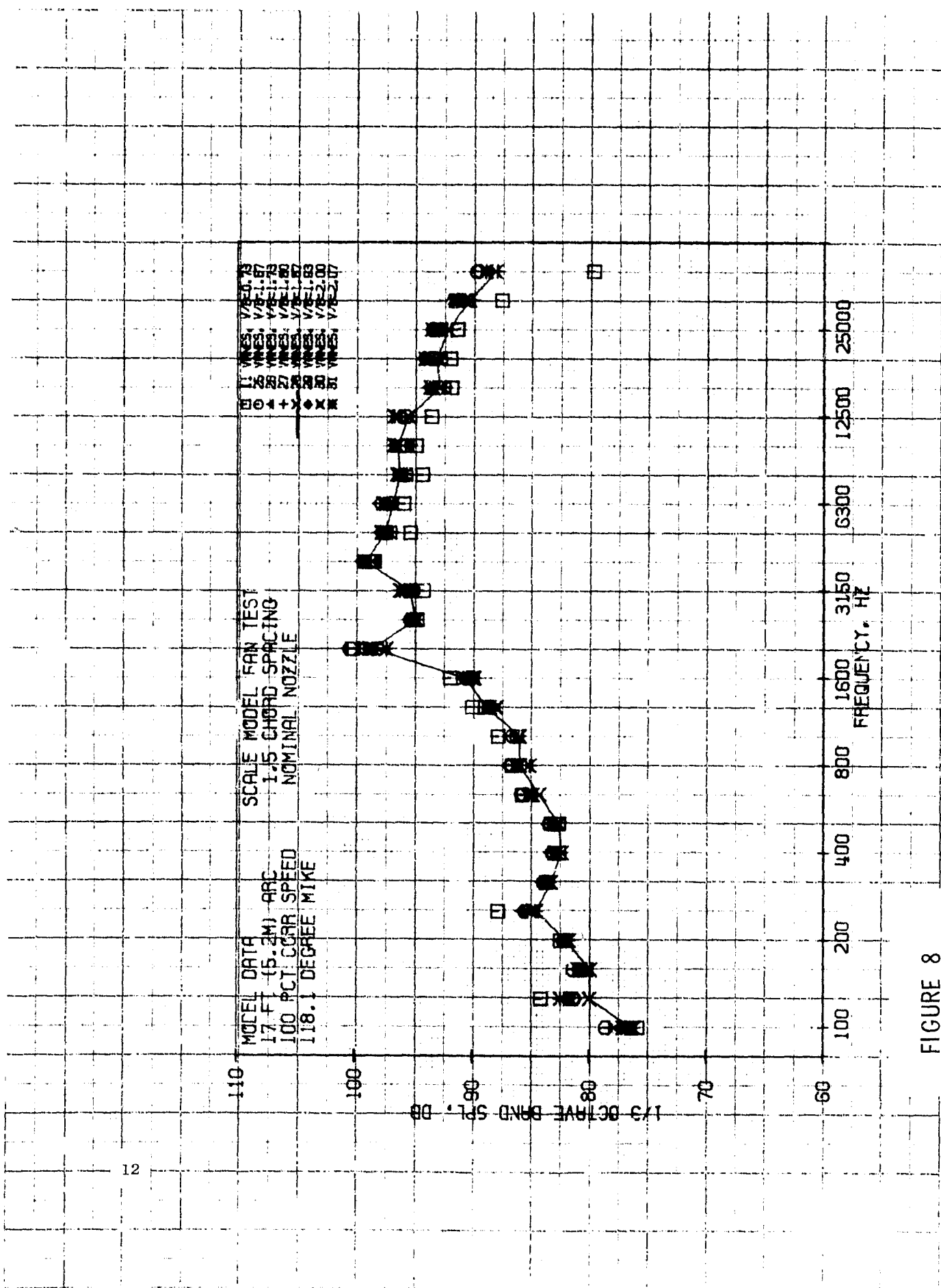


FIGURE 8

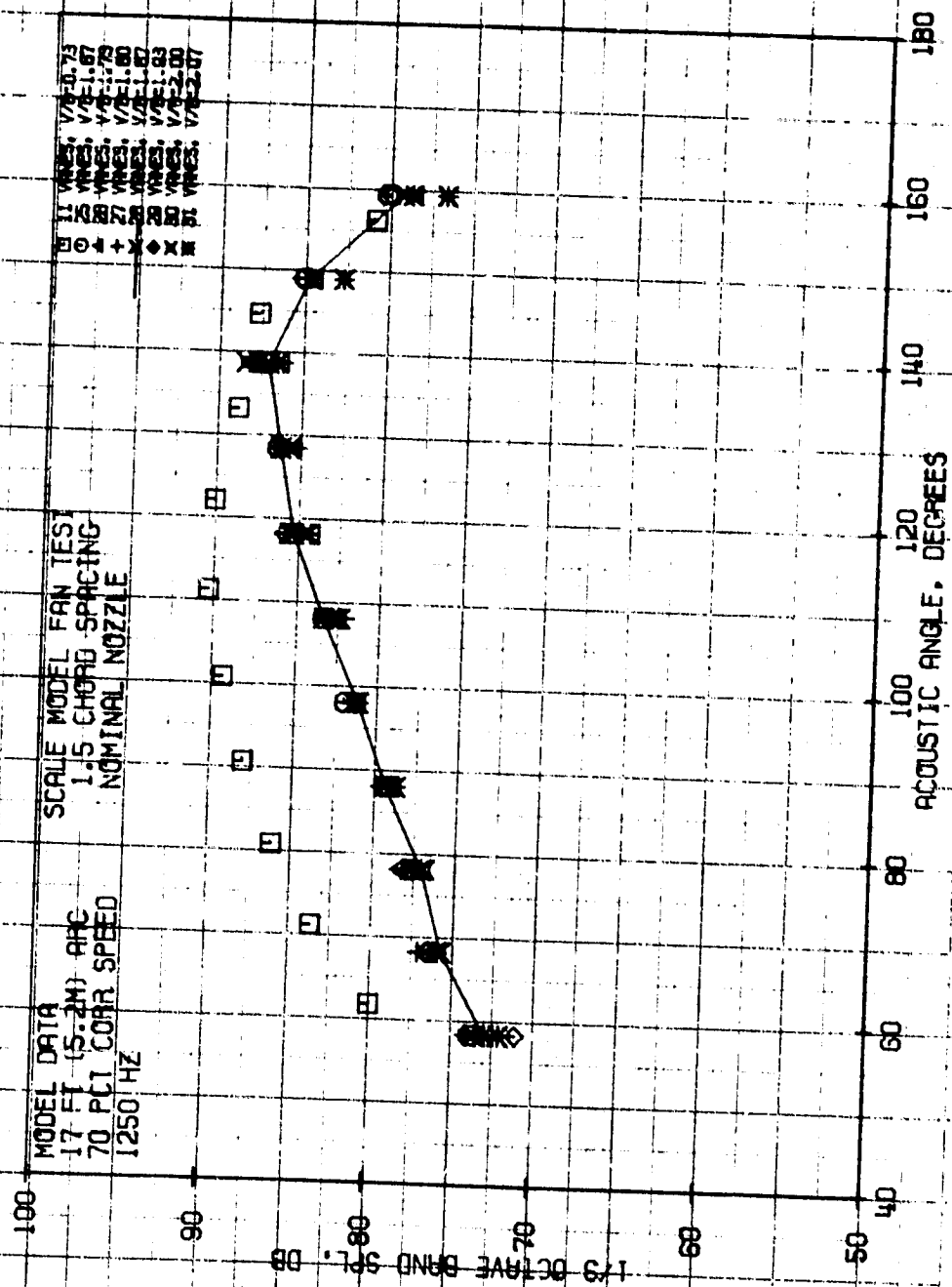


FIGURE 9



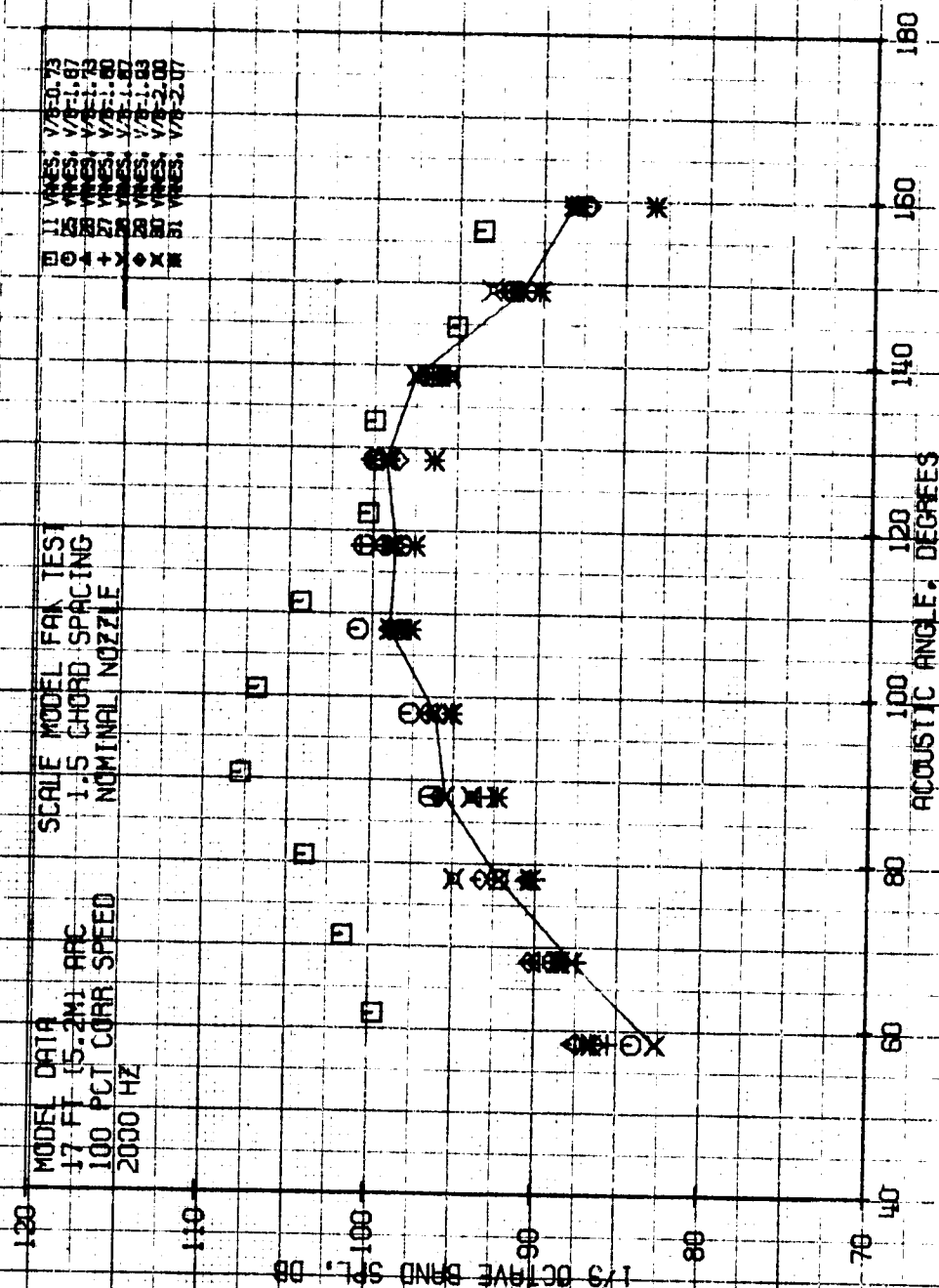


FIGURE 10

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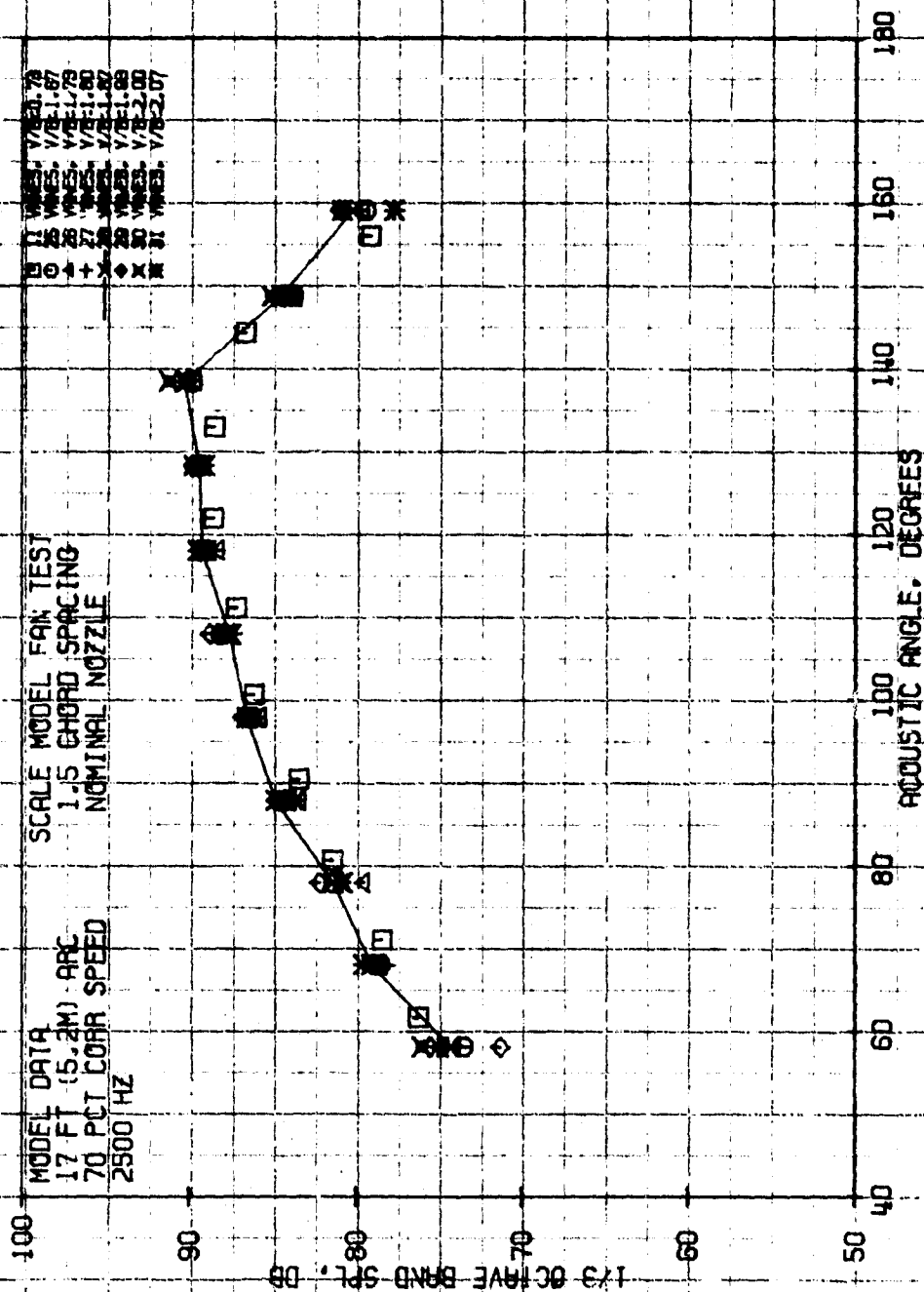


FIGURE II

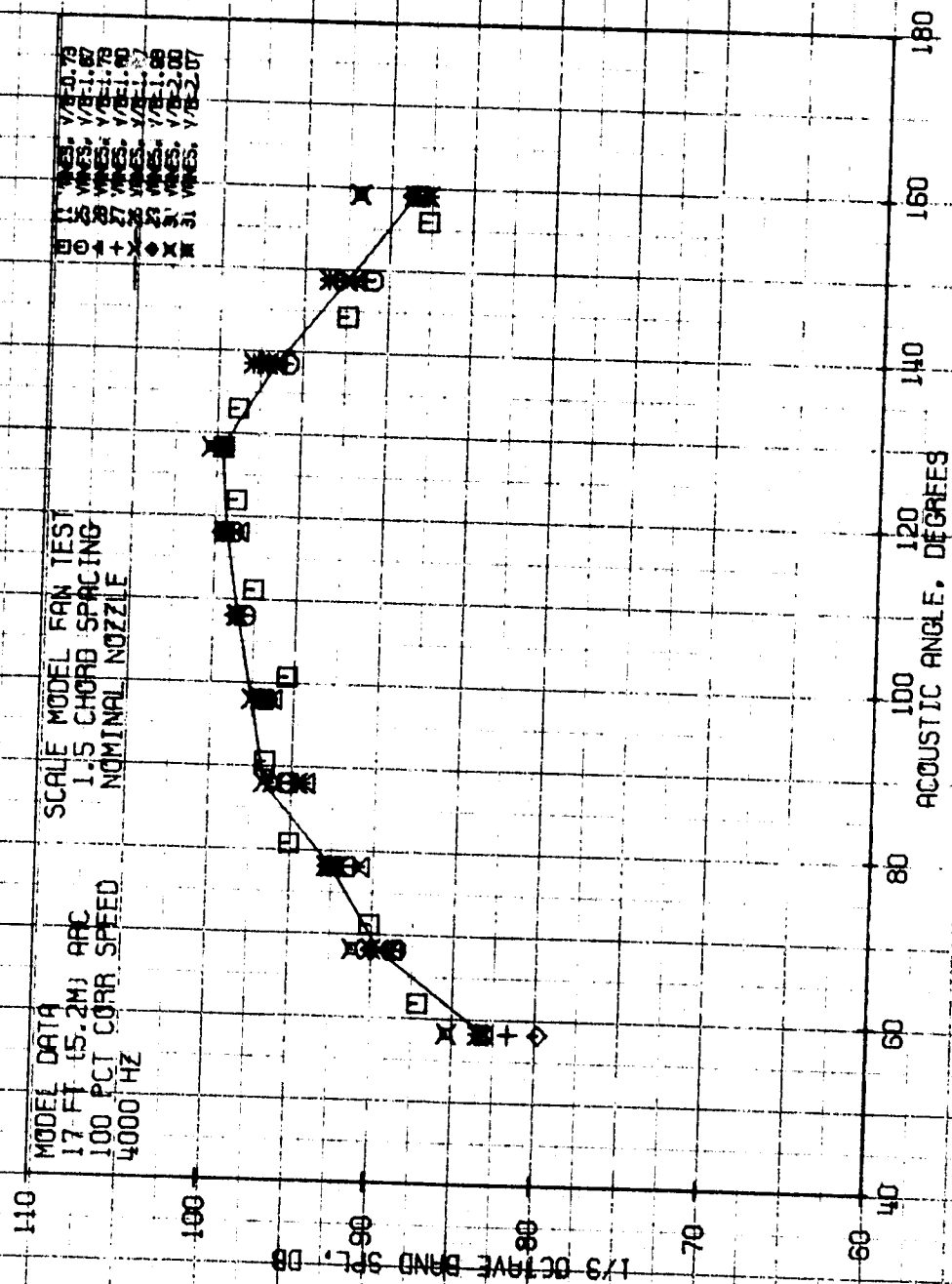


FIGURE 12

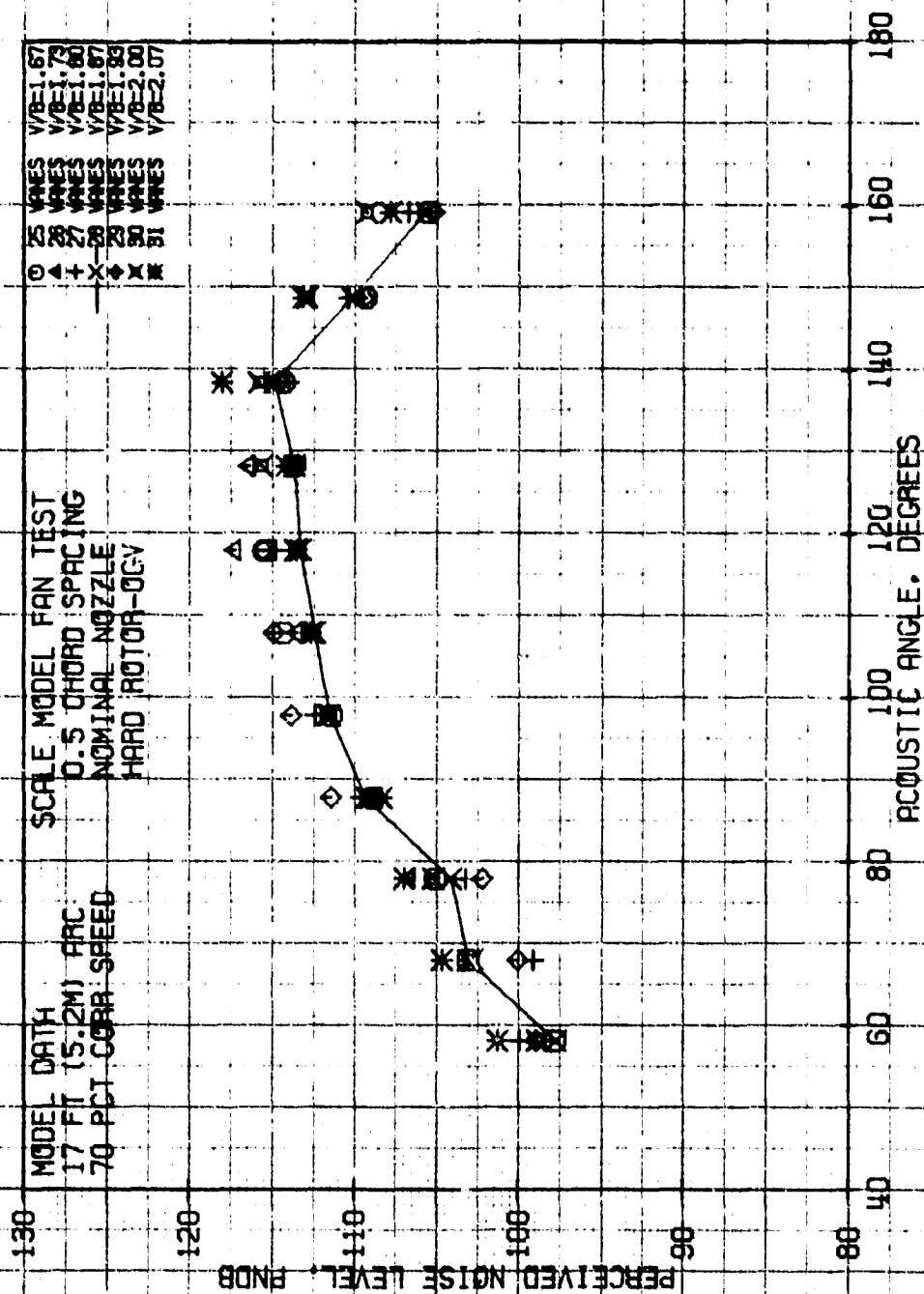


FIGURE 13

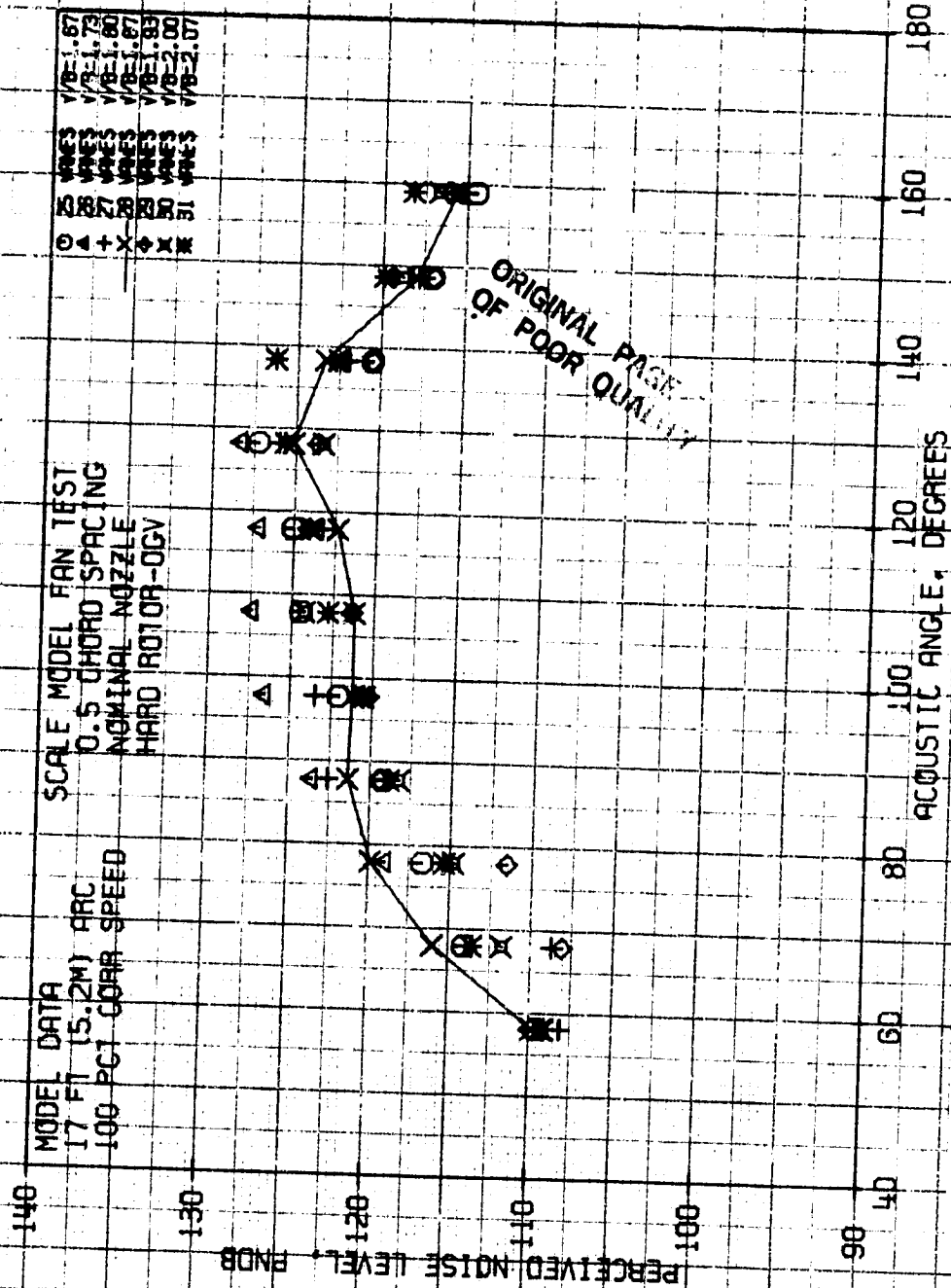


FIGURE 14

MODEL DATA  
 17 FT (5.2M) PFC  
 70 PCT CORR SPEED  
 SCALE MODEL FAN TEST  
 0.5 CHORD SPACING  
 NOMINAL NOZZLE  
 HARD ROTOR-OGV

Symbol	Wavelength (inches)	Wavelength (mm)
○	25	W61.67
△	28	W61.73
+	27	W61.60
×	28	W61.67
◆	28	W61.67
×	30	W61.83
×	30	W62.00
×	31	W62.07

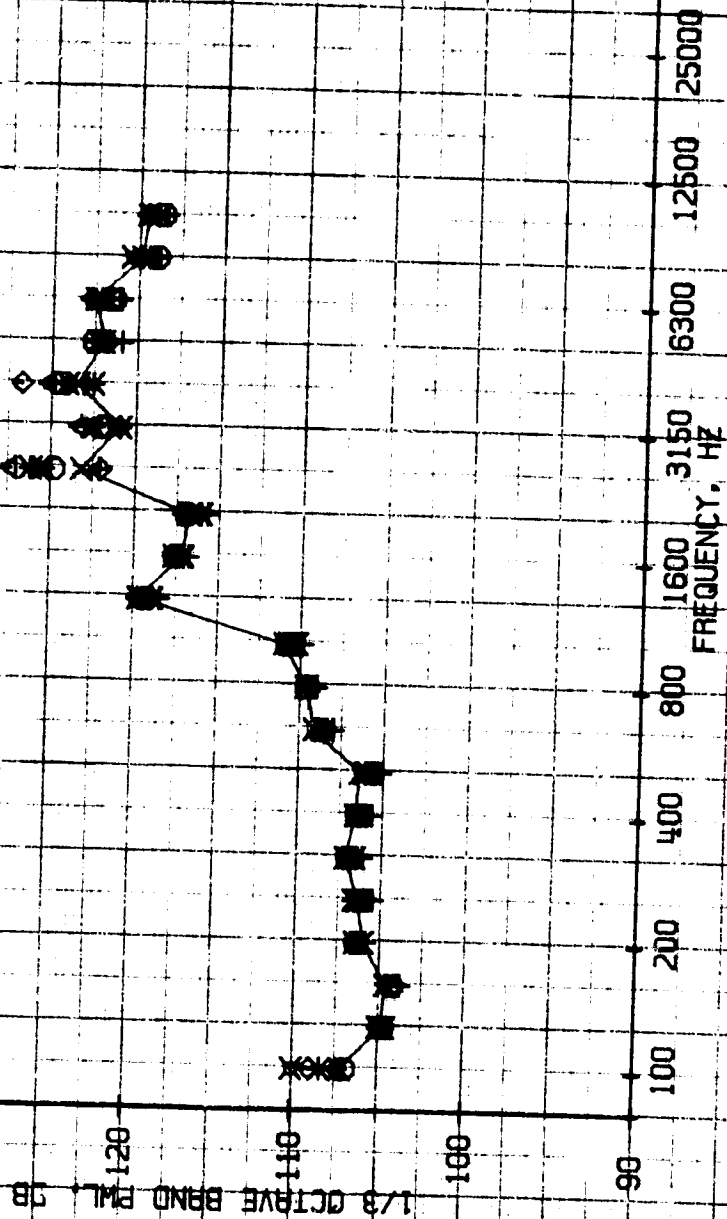


FIGURE 15

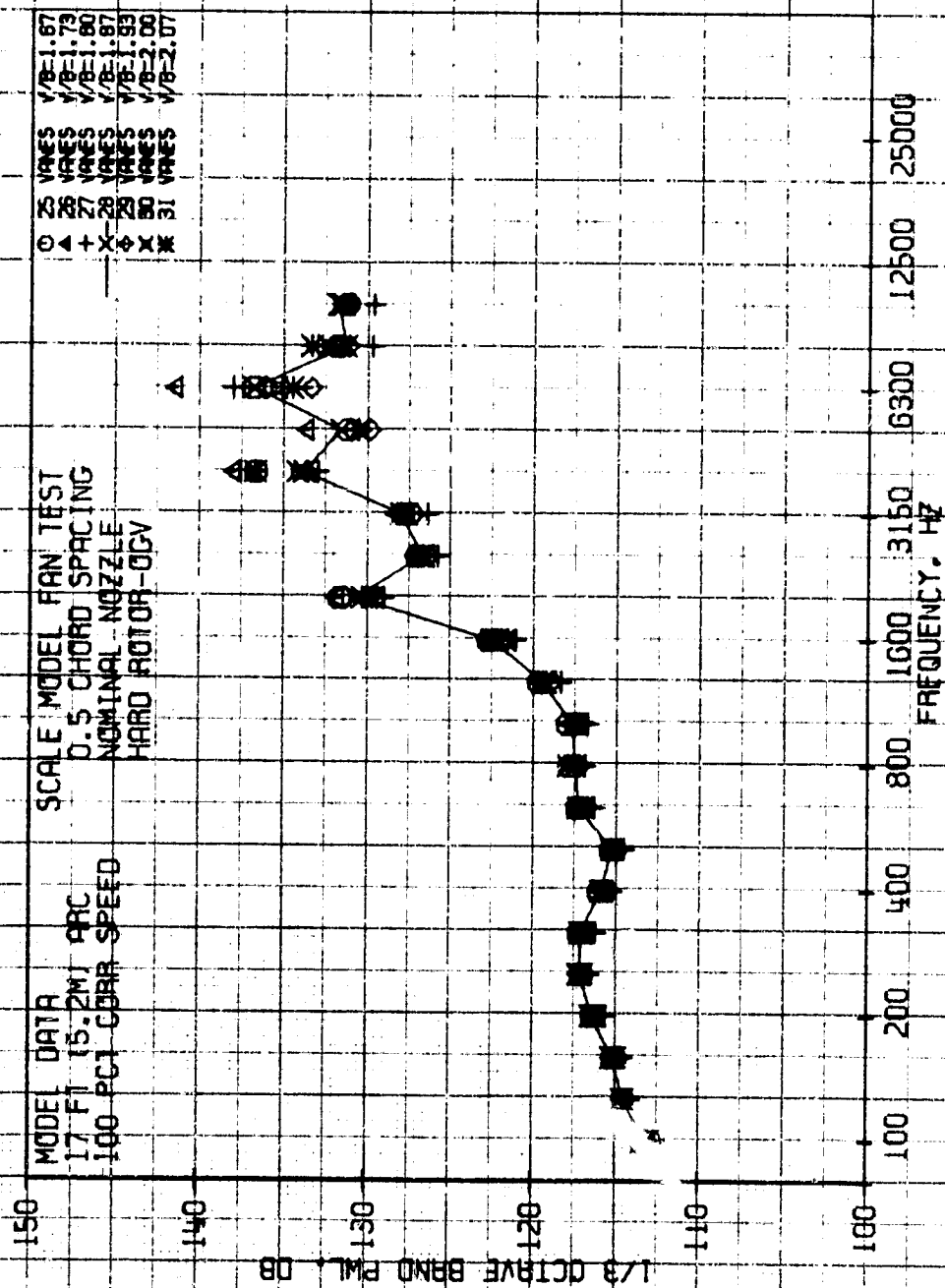


FIGURE 16

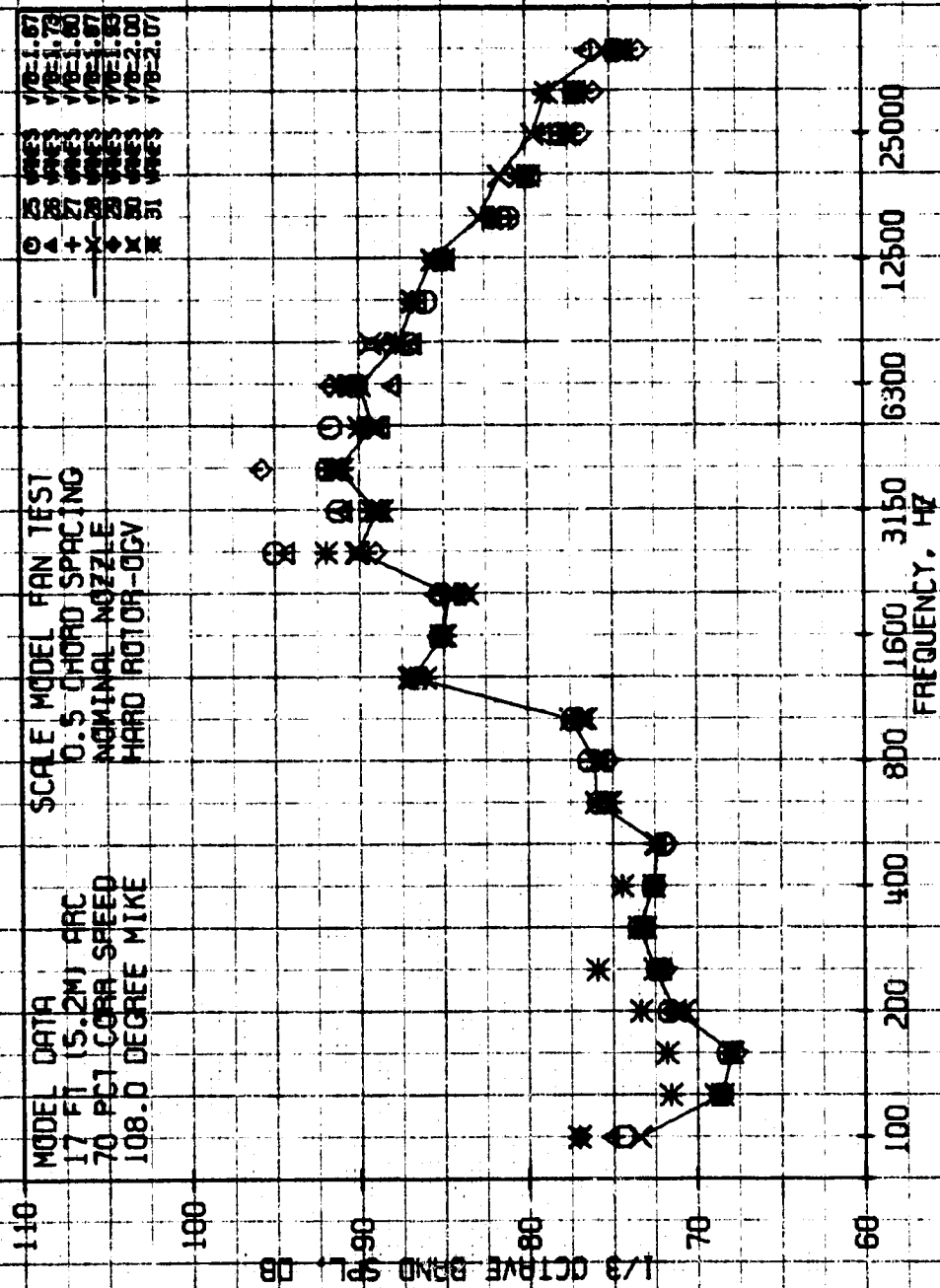


FIGURE 17



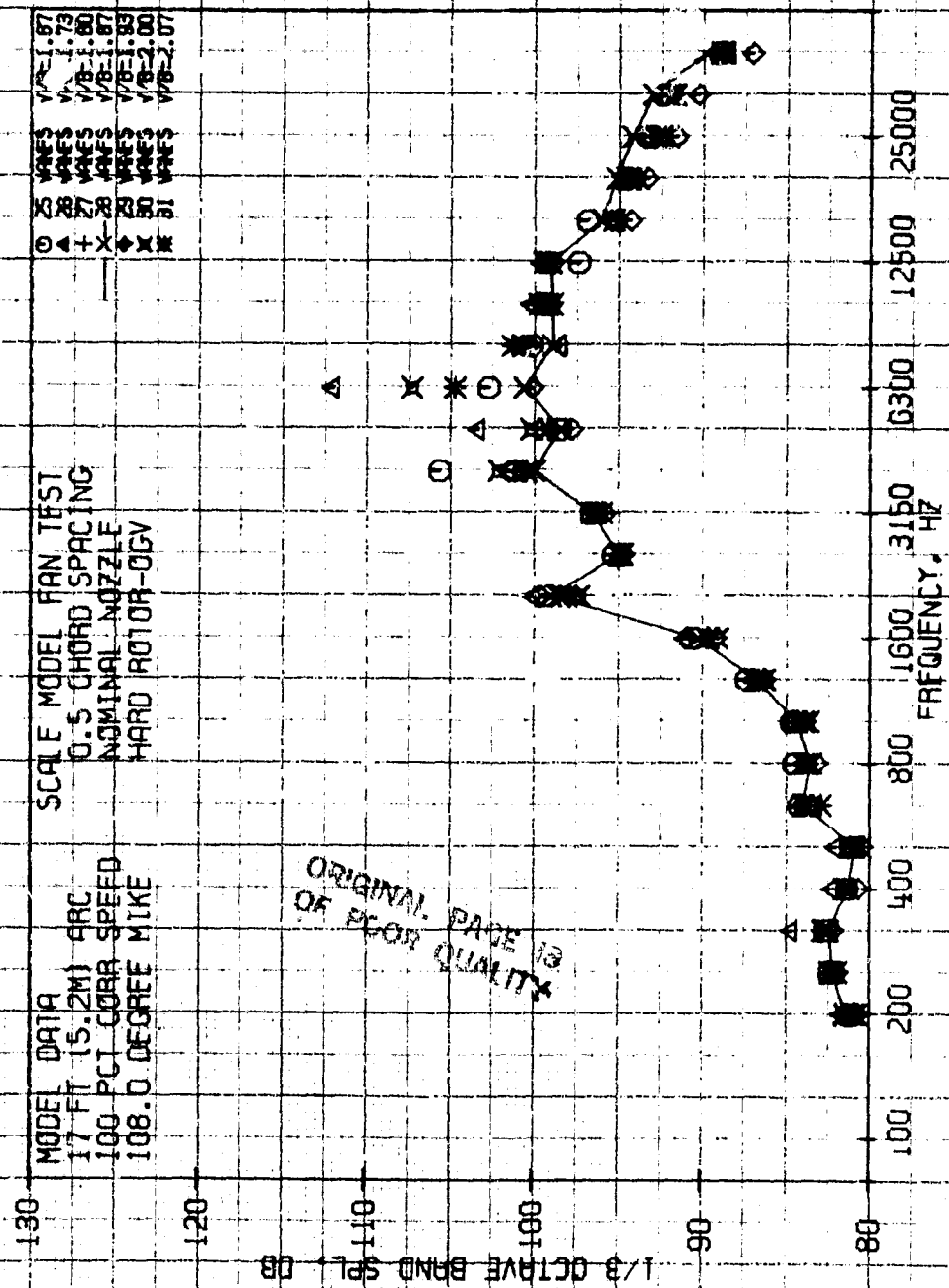


FIGURE 18

MODEL DATA  
 17 FT (5.2M) ARC  
 70 PCT CABR SPEED  
 118.1 DEGREE MIKE

SCALE MODEL FAN TEST  
 0.5 CHORD SPACING  
 NOMINAL NOZZLE  
 HARD ROTOR-OGV

25	WES	W/E-1.67
28	WES	W/E-1.73
27	WES	W/E-1.80
28	WES	W/E-1.87
29	WES	W/E-1.89
30	WES	W/E-2.00
31	WES	W/E-2.07

O Δ + X \*

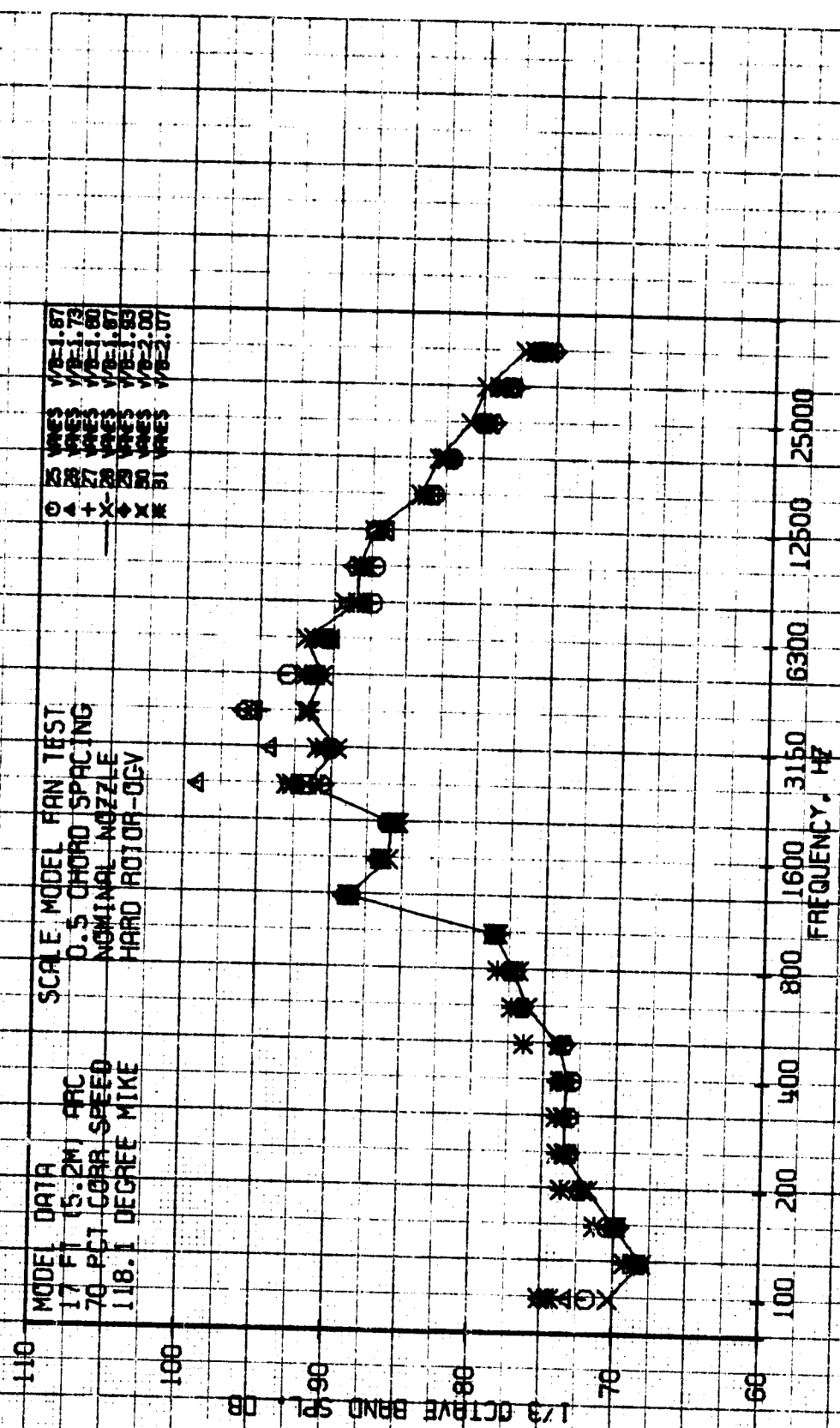


FIGURE 19

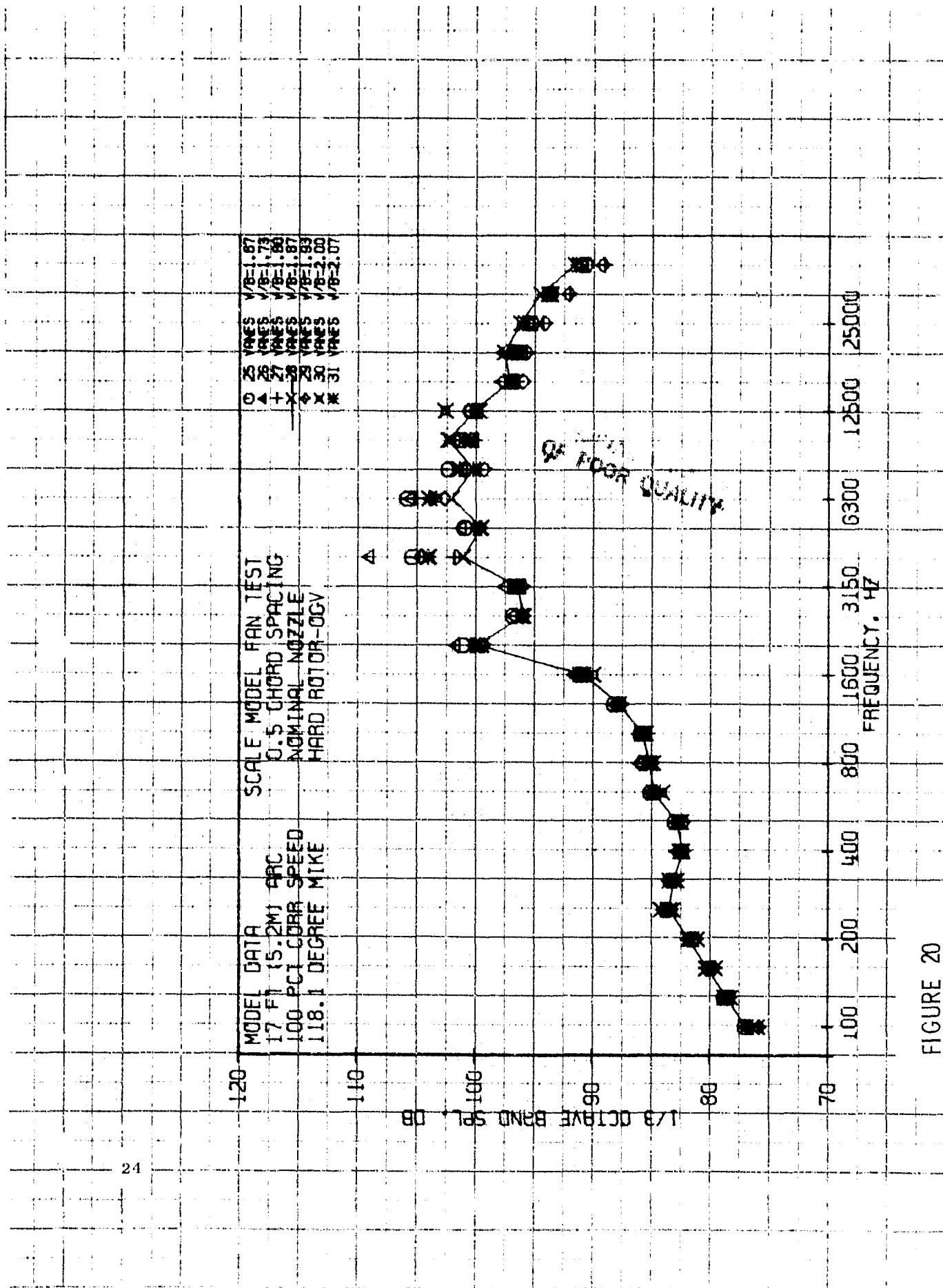


FIGURE 20

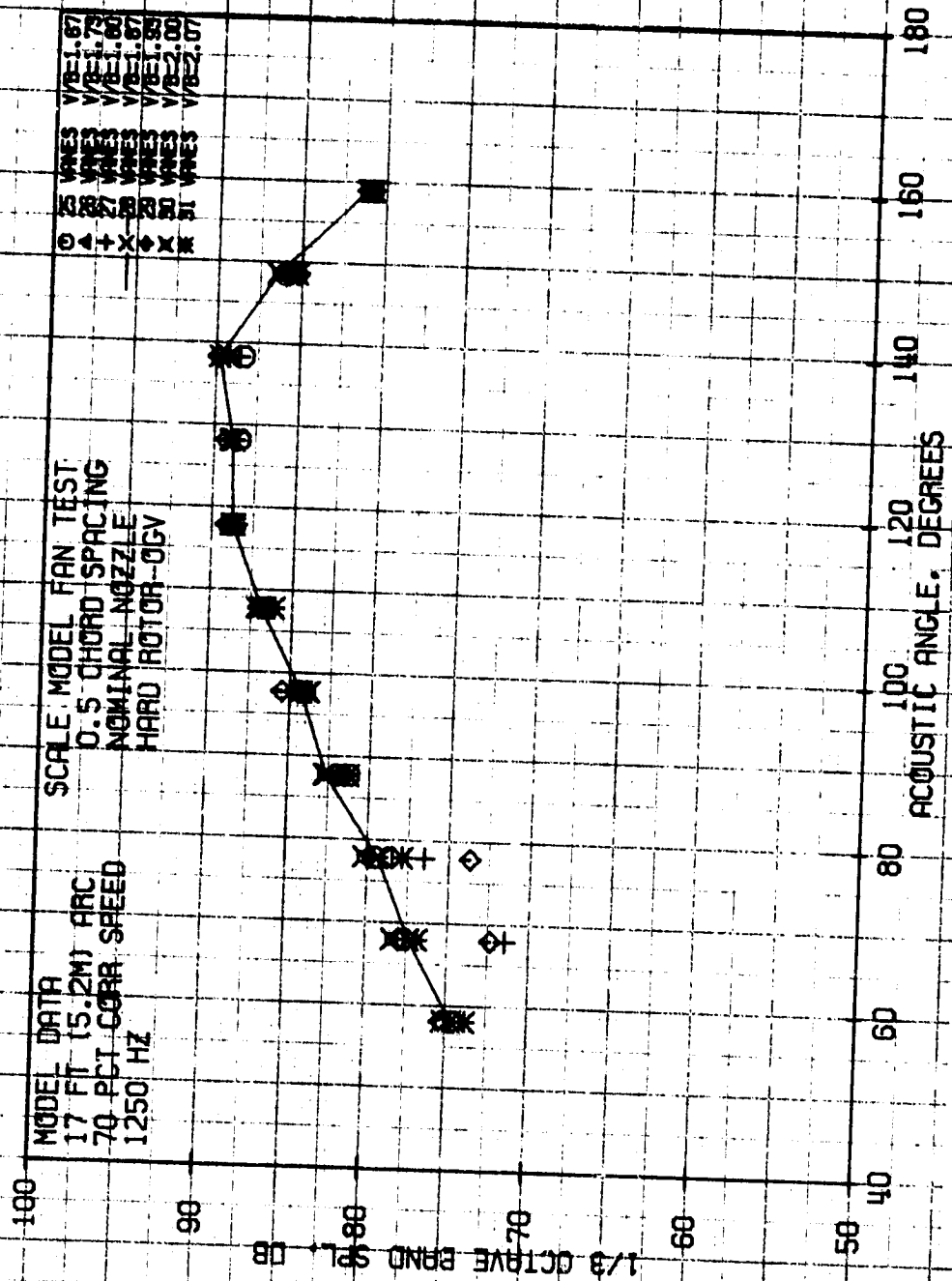


FIGURE 21

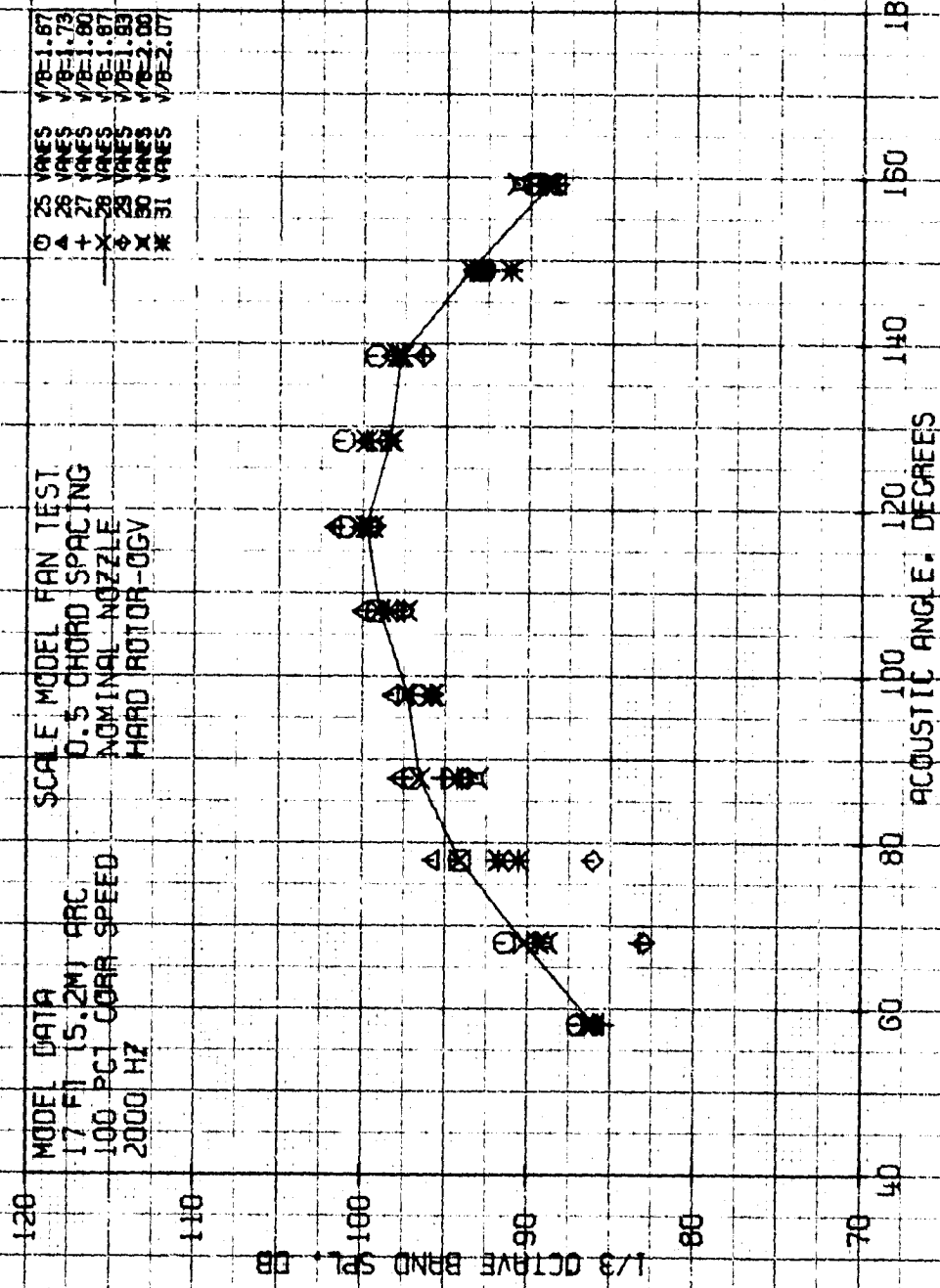


FIGURE 22

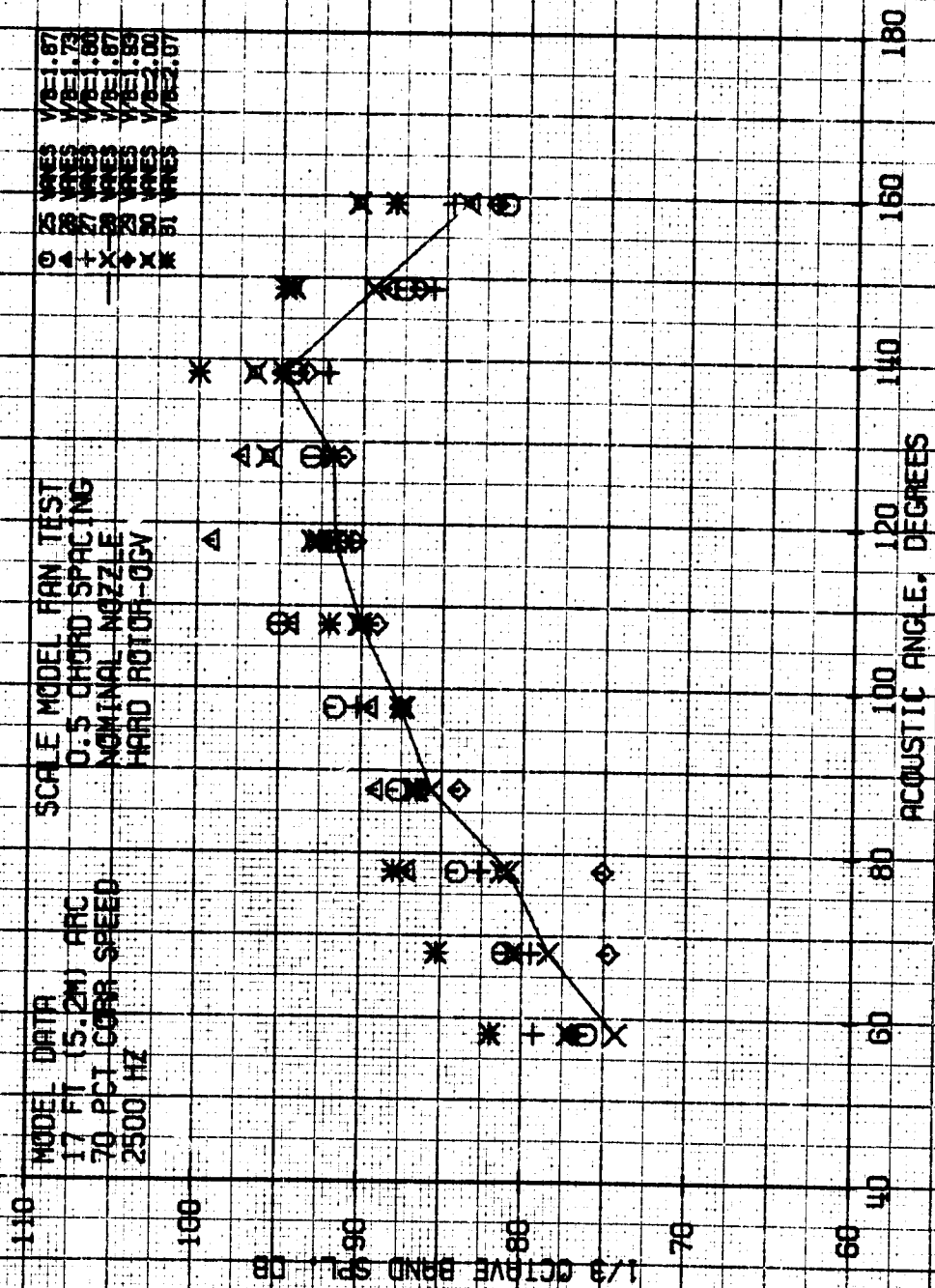


FIGURE 23

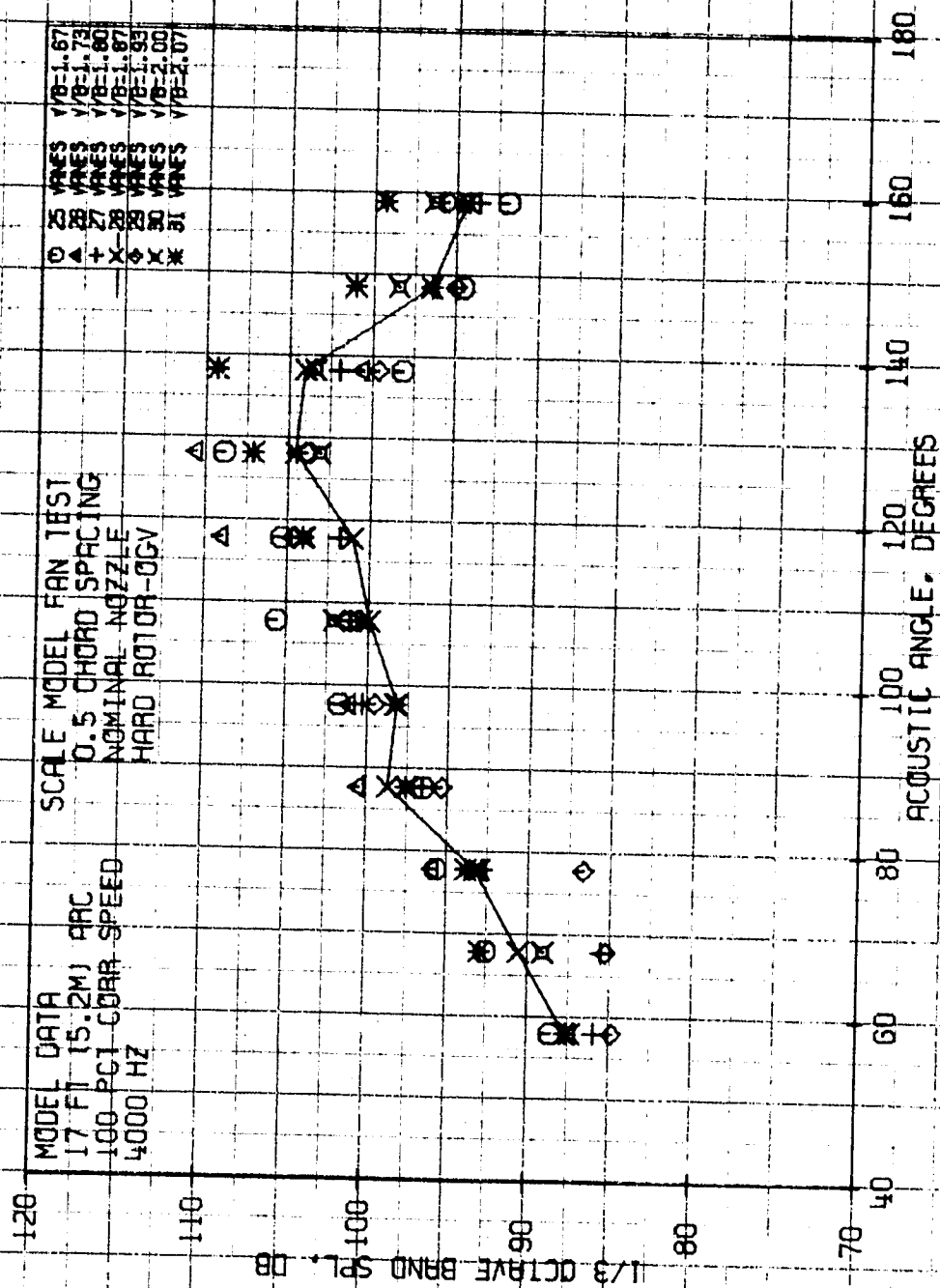


FIGURE 24

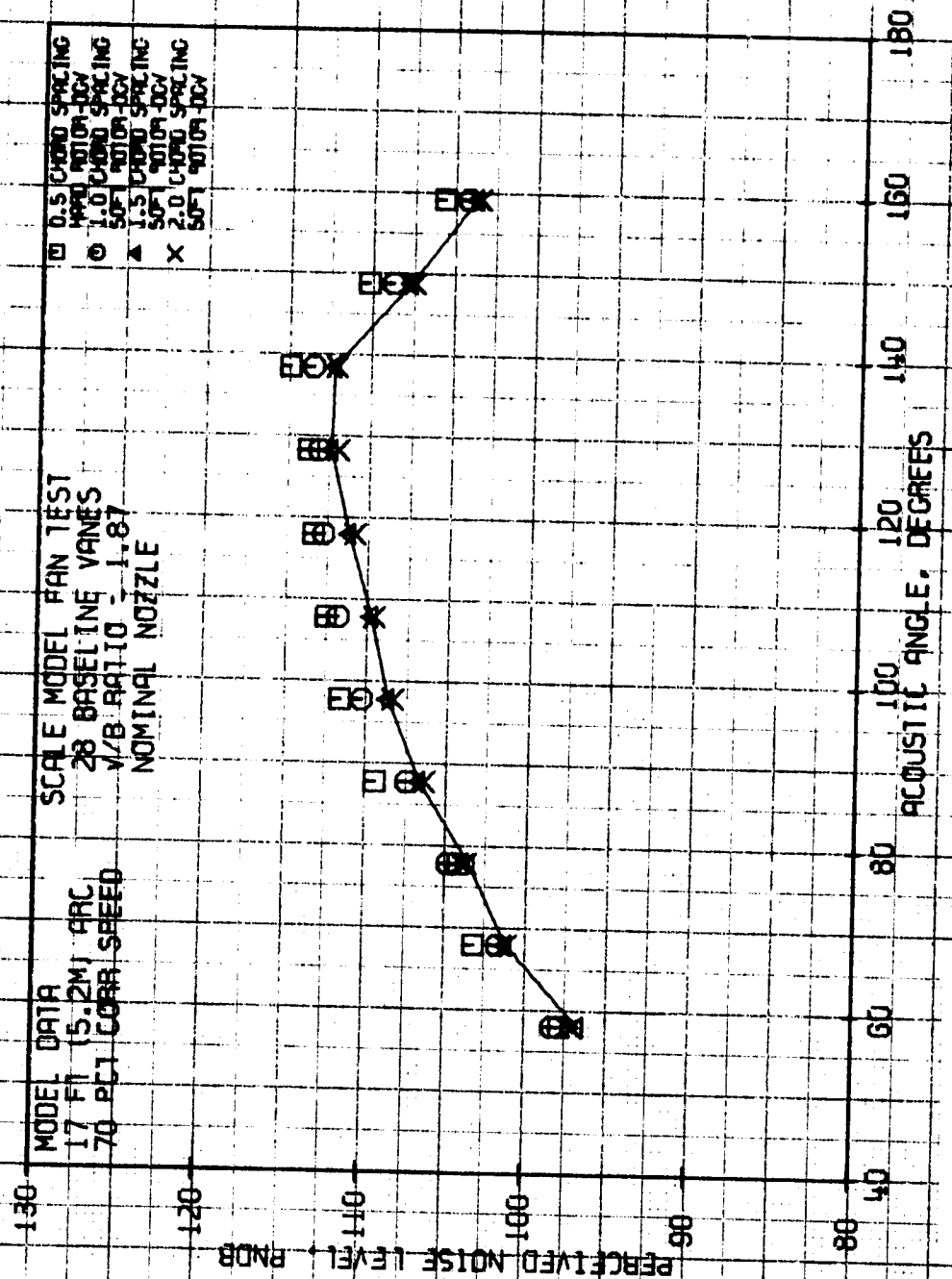


FIGURE 25



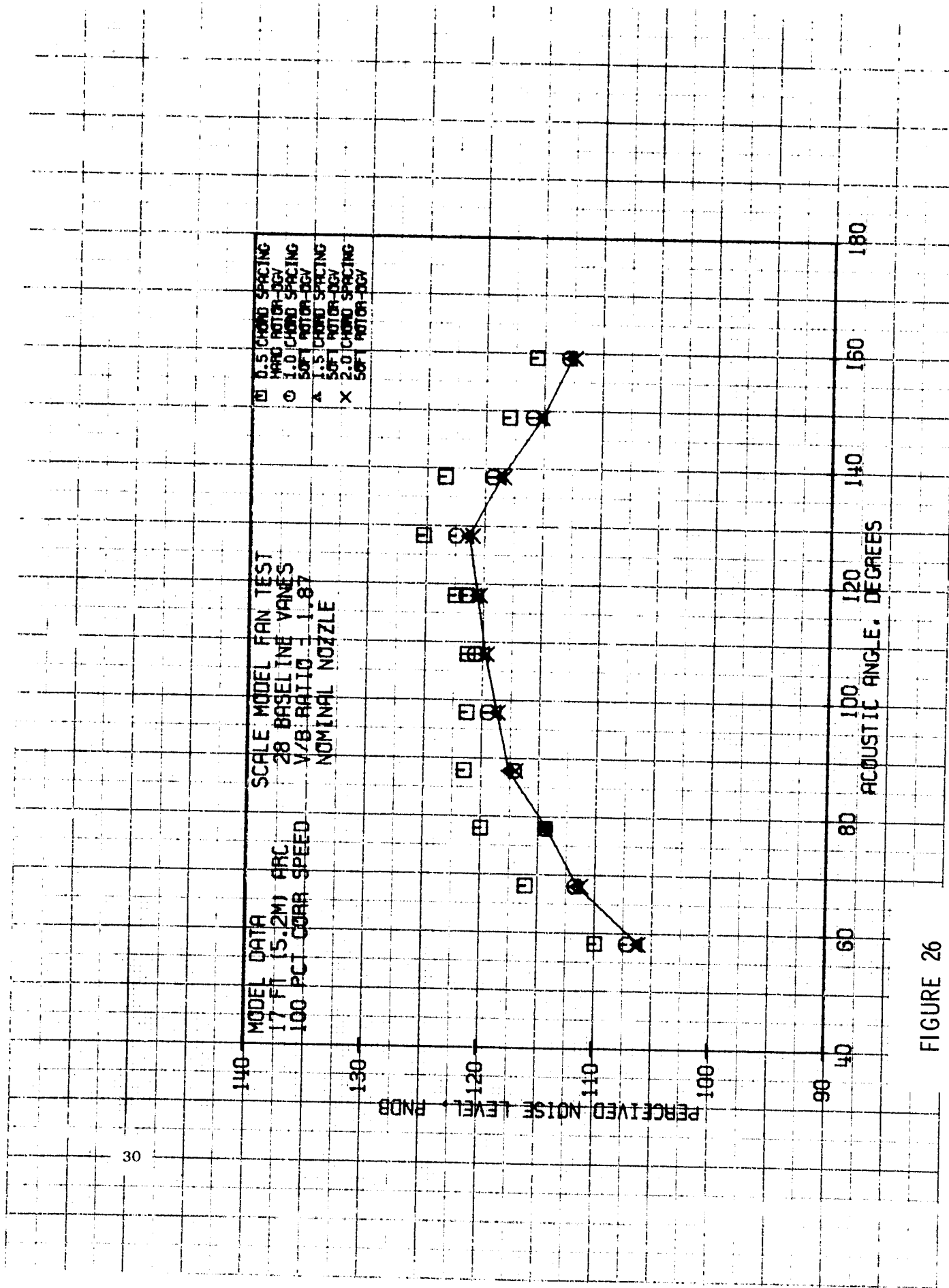


FIGURE 26

MODEL DATA  
 17 FT (5.2M) ARC  
 70 PSI CORR SPEED  
 SCALE MODEL FAN TEST  
 28 BASELINE VANES  
 W/B RATIO = 1.87  
 NOMINAL NOZZLE

1/8 OCTAVE BAND P.L. DB  
 140  
 130  
 120  
 110  
 100  
 90

0.5 CHORD SPACING  
 1.0 CHORD SPACING  
 1.5 CHORD SPACING  
 2.0 CHORD SPACING  
 50% ROTOR-DOV  
 50% ROTOR-DOV  
 50% ROTOR-DOV  
 50% ROTOR-DOV  
 50% ROTOR-DOV

100 200 400 800 1600 3150 6300 12500 25000  
 FREQUENCY, HZ

1/8 OCTAVE BAND P.L. DB

FIGURE 27

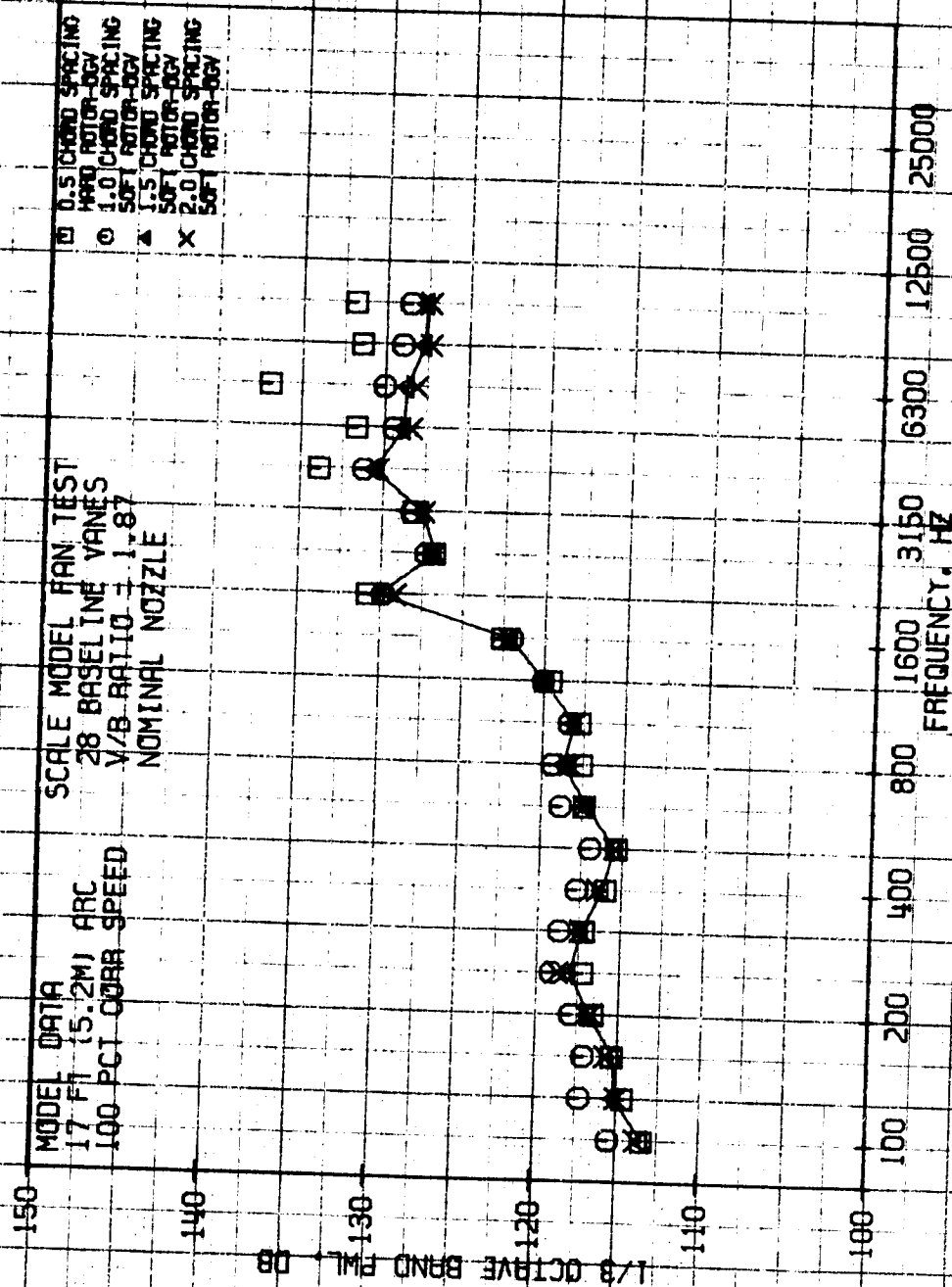


FIGURE 28

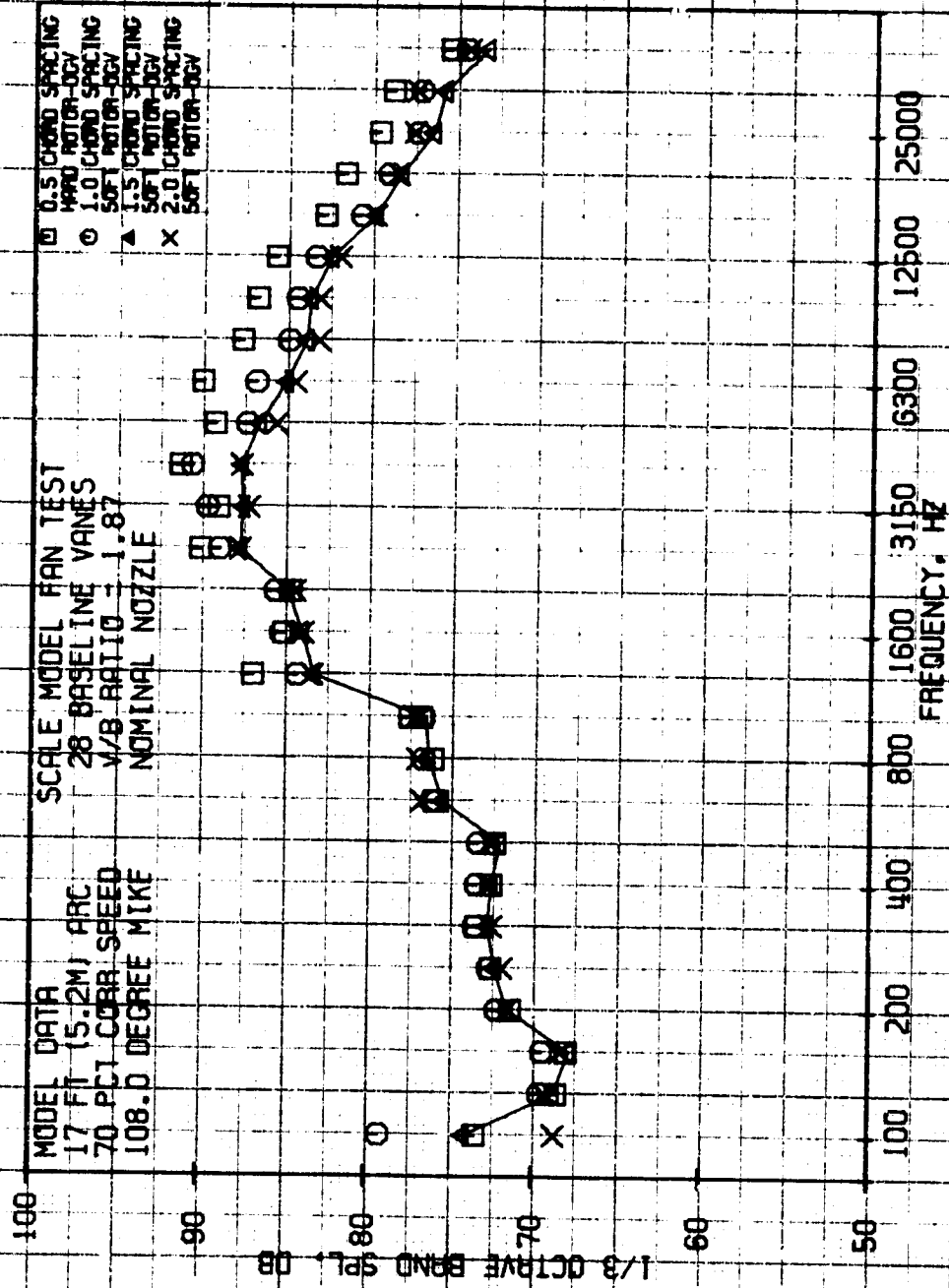


FIGURE 29

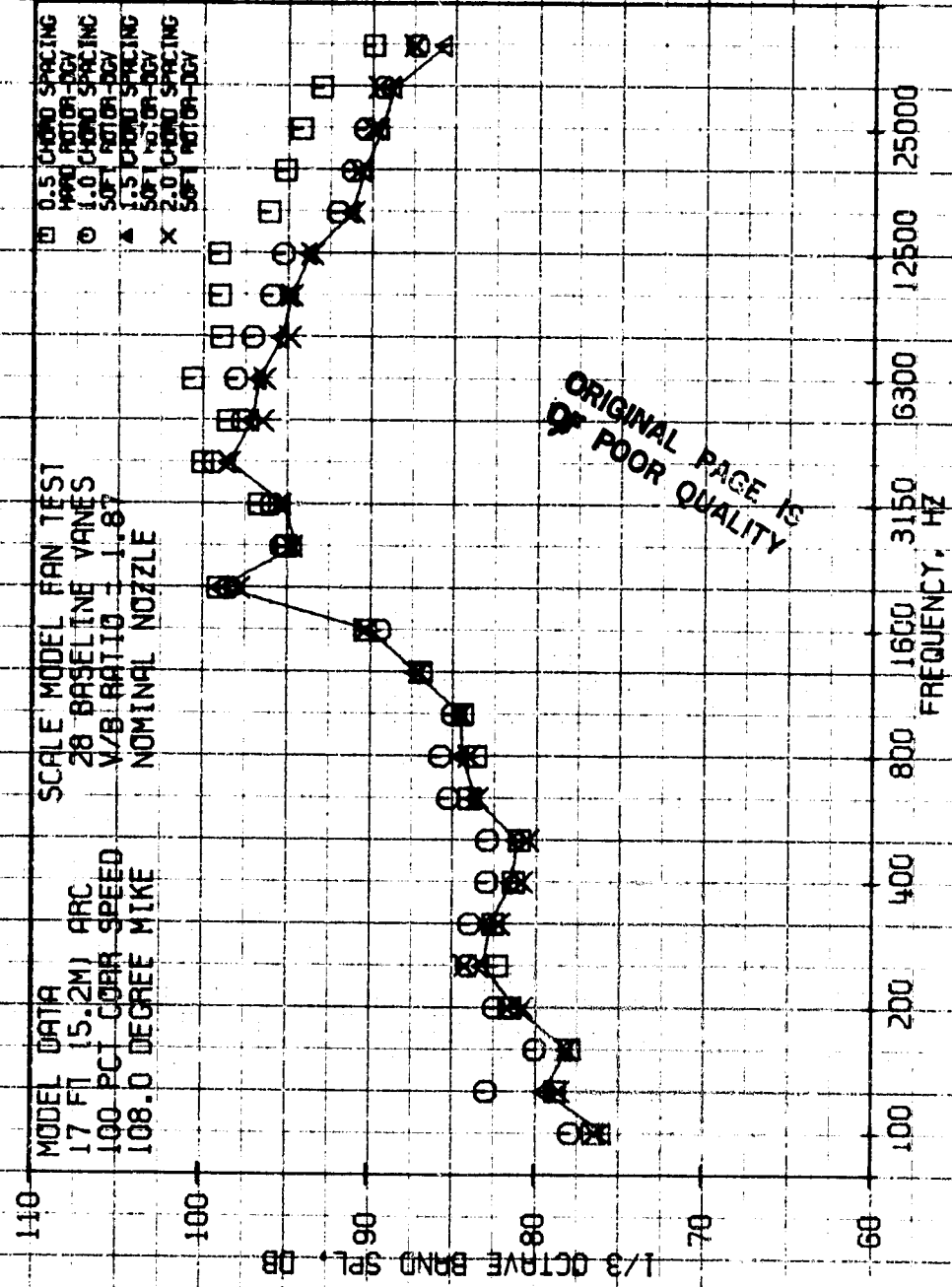


FIGURE 30

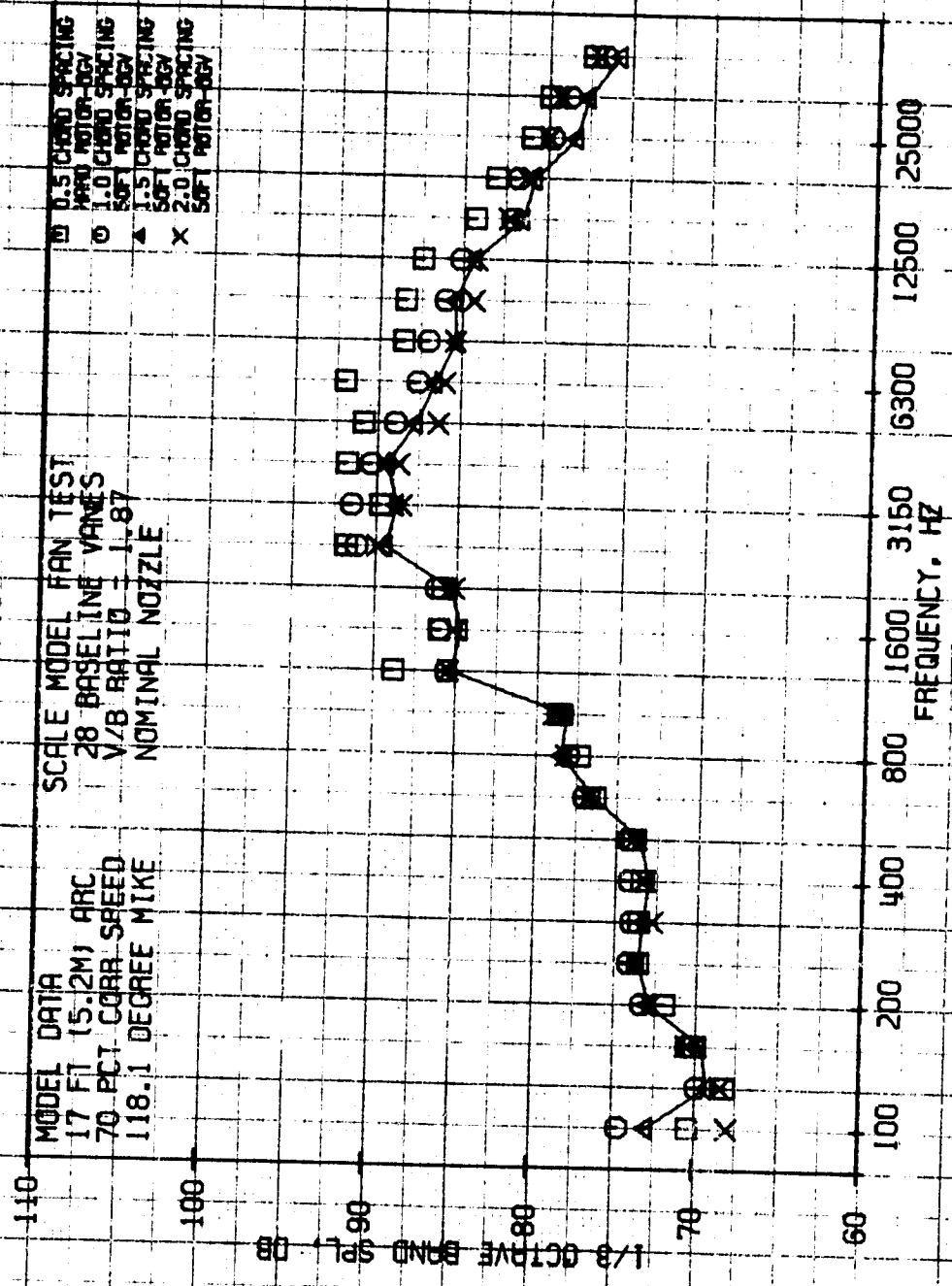
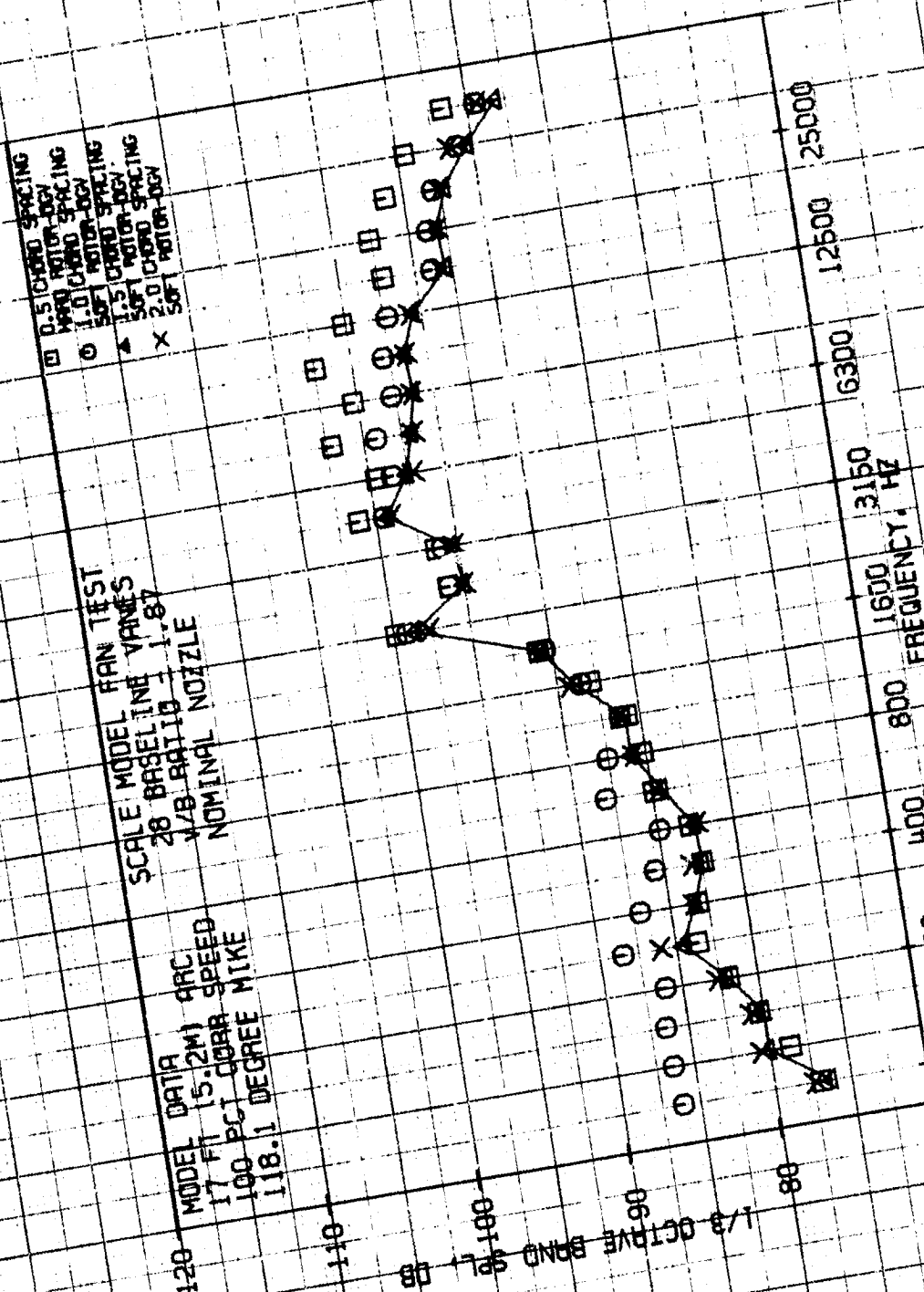


FIGURE 31



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FIGURE 32

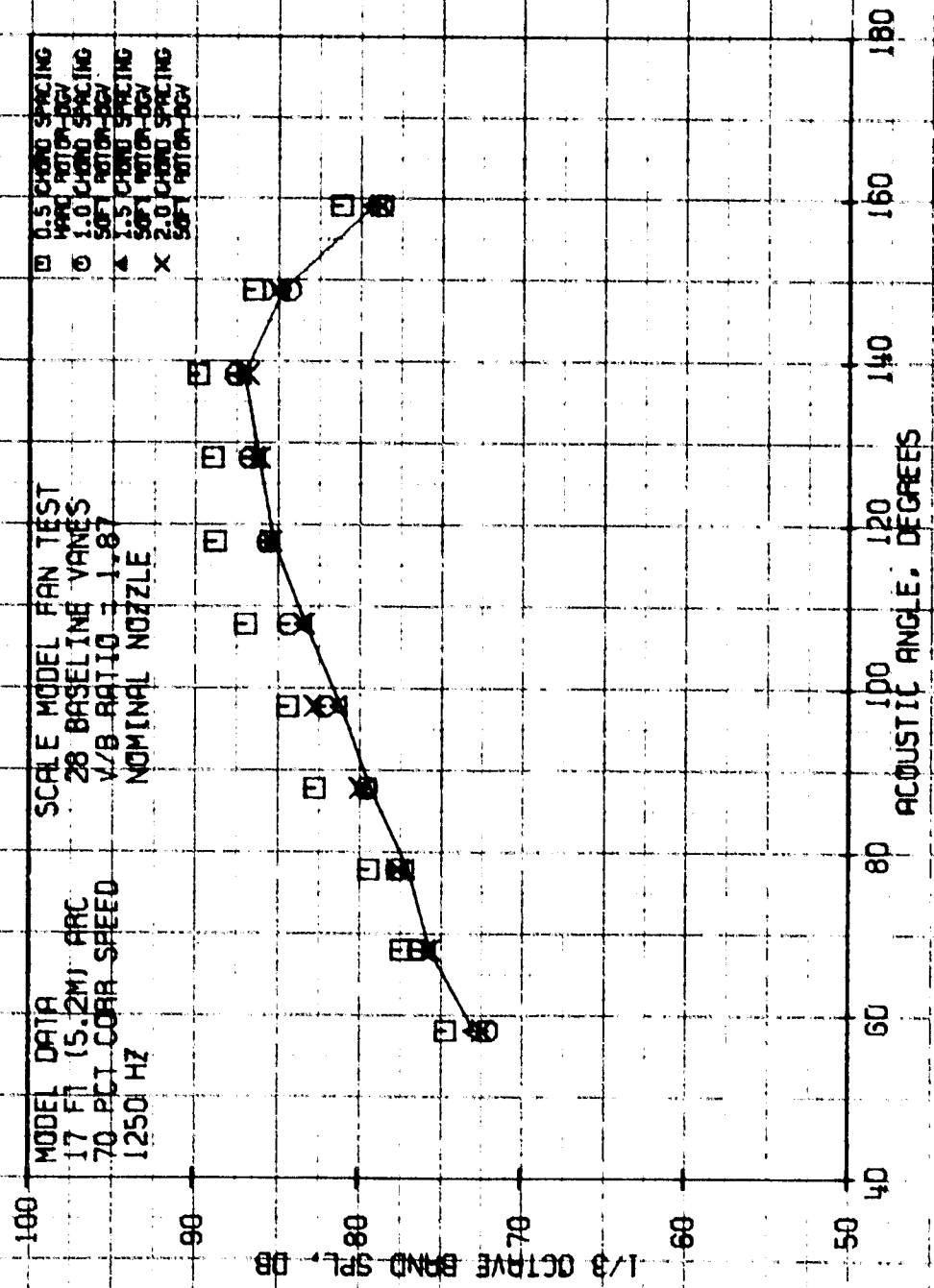


FIGURE 33



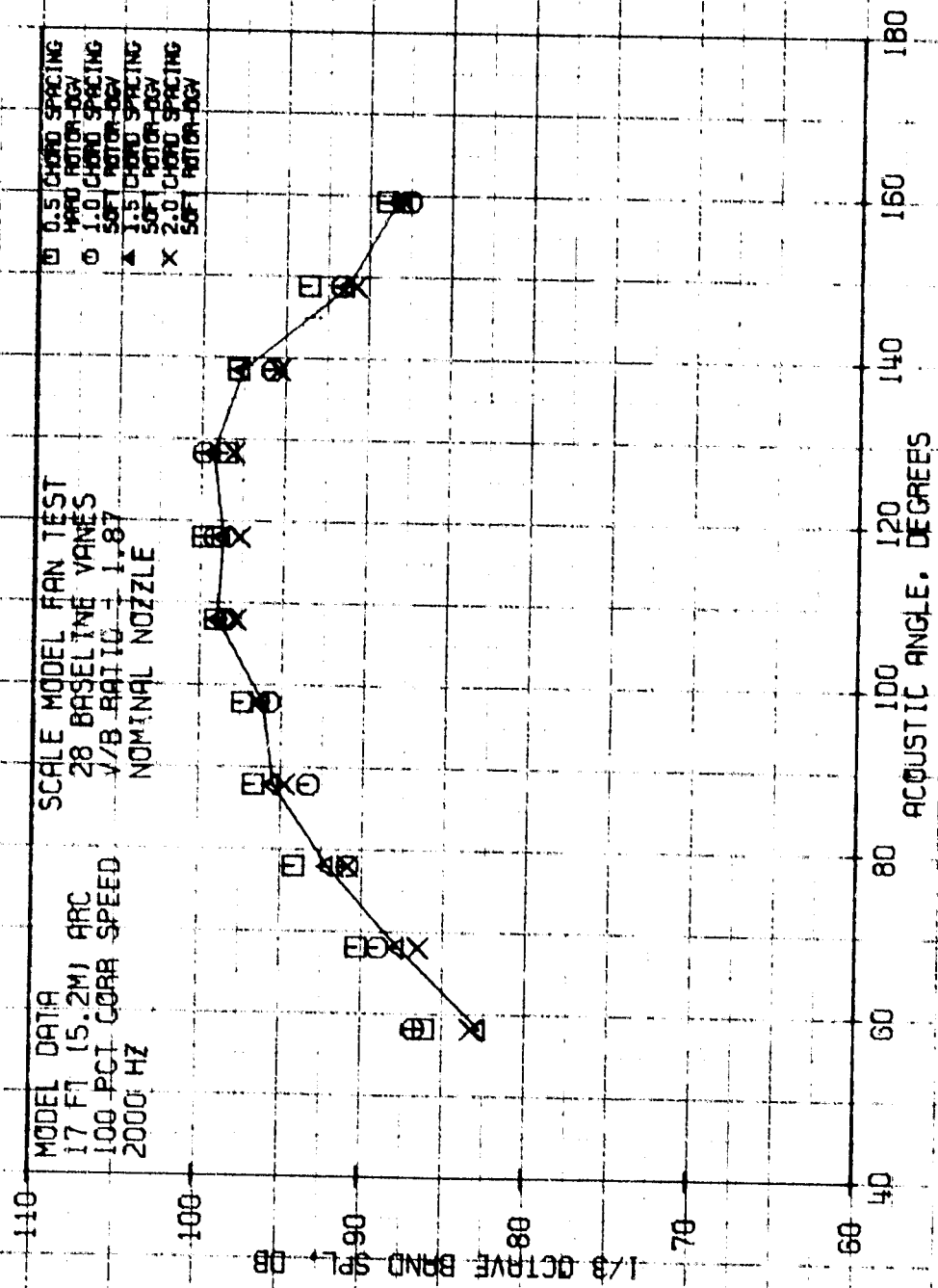


FIGURE 34

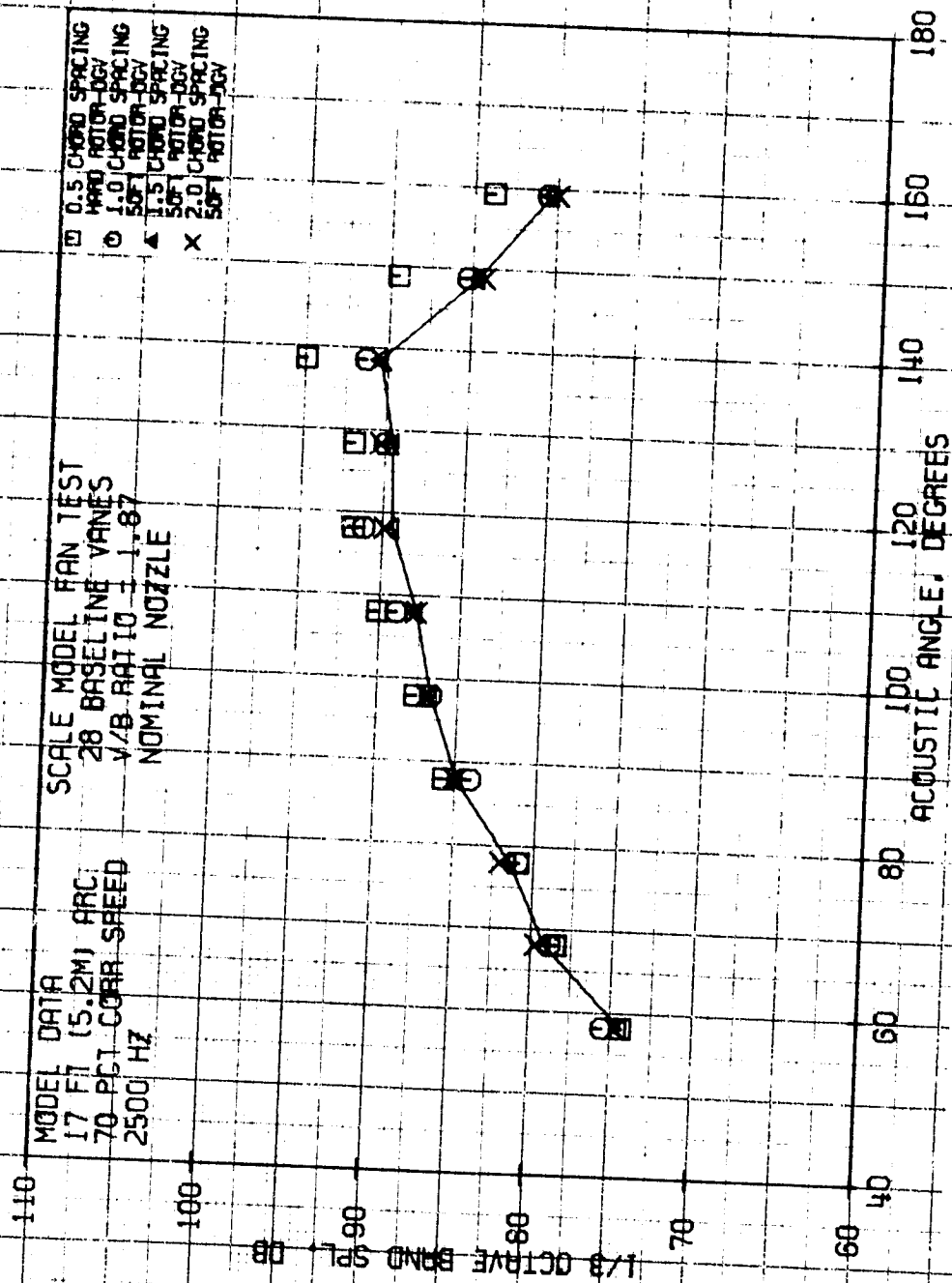


FIGURE 35

1/3 OCTAVE BAND SPL, DB  
 110  
 100  
 90  
 80

SCALE MODEL HAN TEST  
 26 BASELINE VAMES  
 1/3 OCTAVE BAND SPL  
 110  
 100  
 90  
 80

1/3 OCTAVE BAND SPL, DB  
 110  
 100  
 90  
 80

1/3 OCTAVE BAND SPL, DB  
 110  
 100  
 90  
 80

1/3 OCTAVE BAND SPL, DB  
 110  
 100  
 90  
 80

1/3 OCTAVE BAND SPL, DB  
 110  
 100  
 90  
 80

1/3 OCTAVE BAND SPL, DB  
 110  
 100  
 90  
 80

1/3 OCTAVE BAND SPL, DB  
 110  
 100  
 90  
 80

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 OF POOR QUALITY

FIGURE 36

7851482

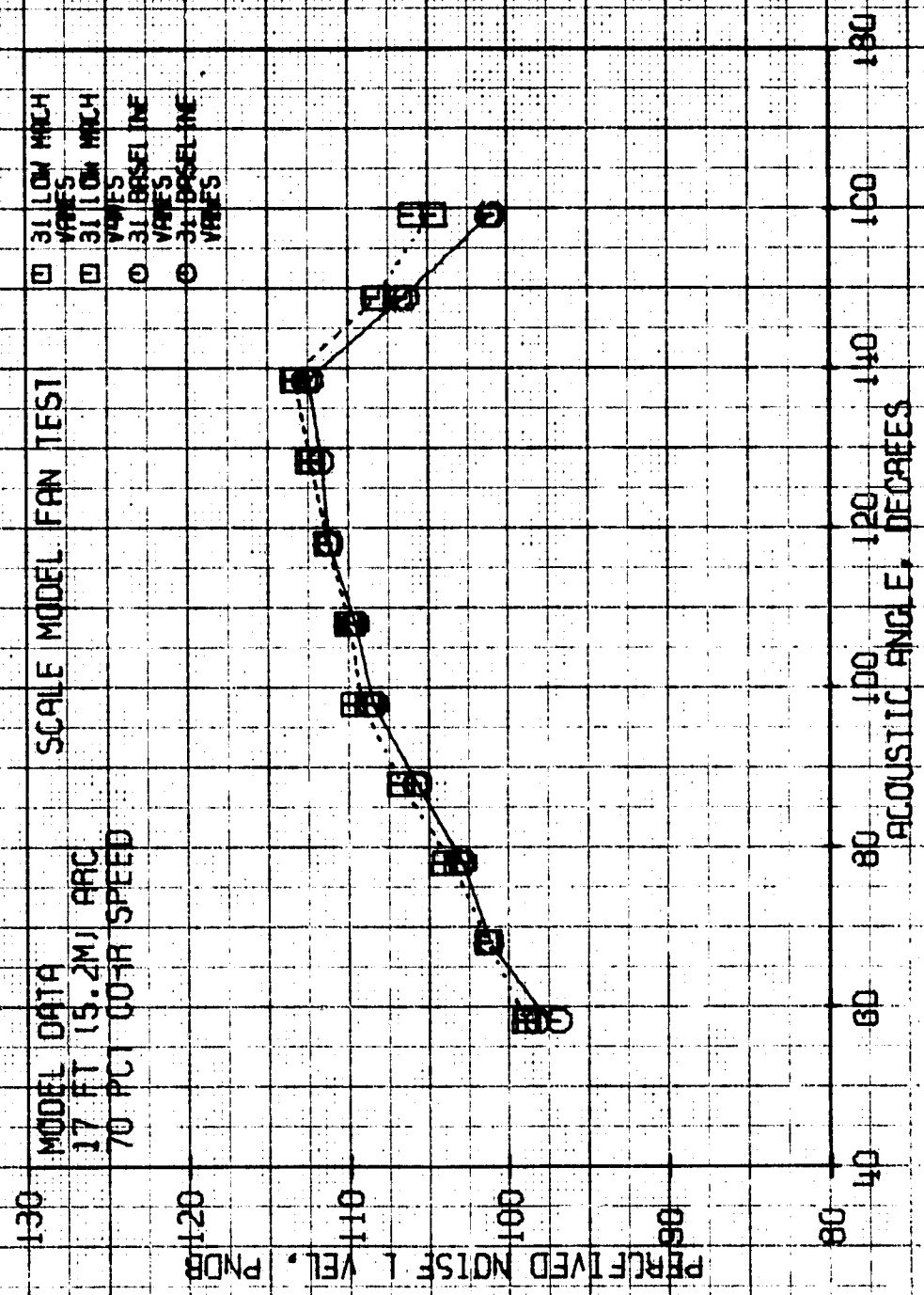


FIGURE 37

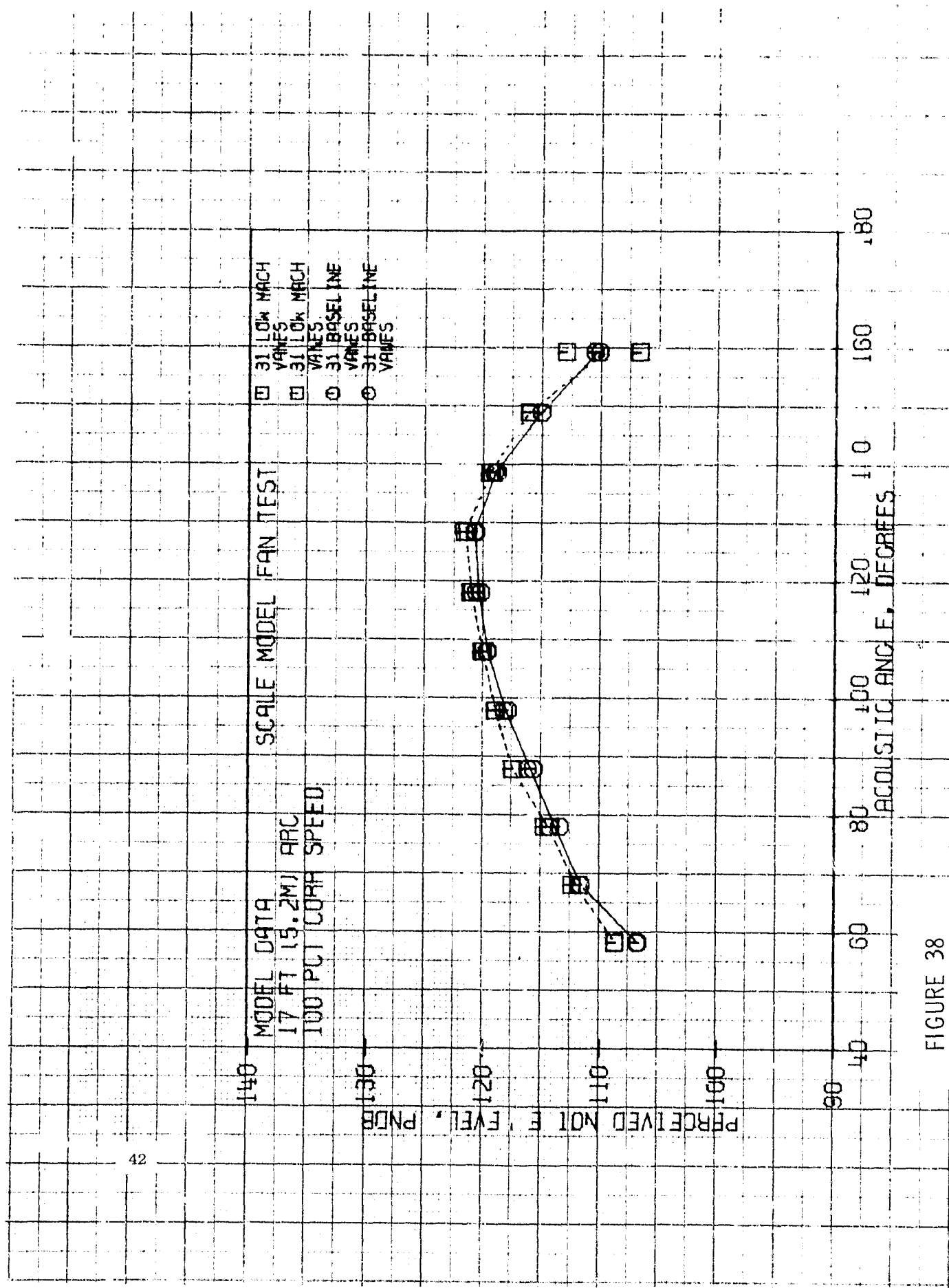


FIGURE 38

MODEL DATA  
17 FT (5.2M) ARC  
70 PC COAR SPEED

SCALE MODEL FAN TEST

31 LOW MACH  
VALUES

31 LOW MACH  
VALUES

31 BASELINE  
VALUES

31 BASELINE  
VALUES

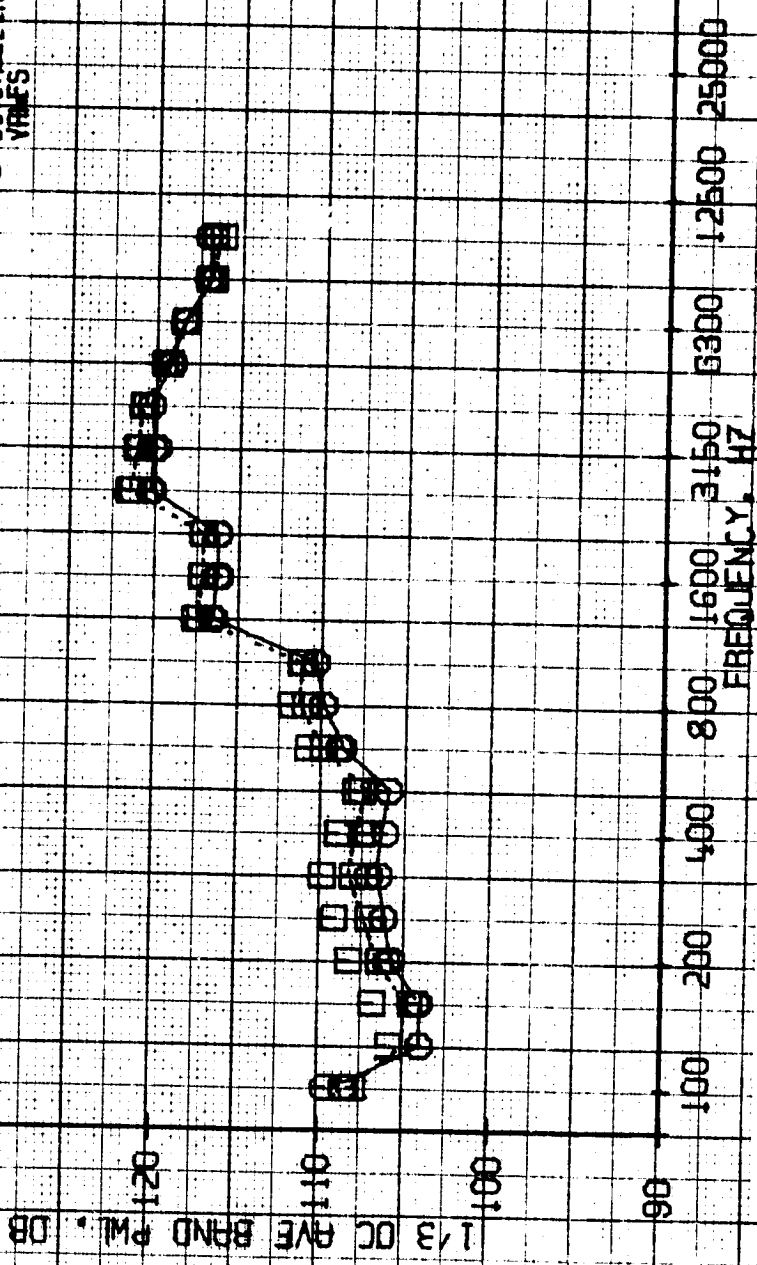
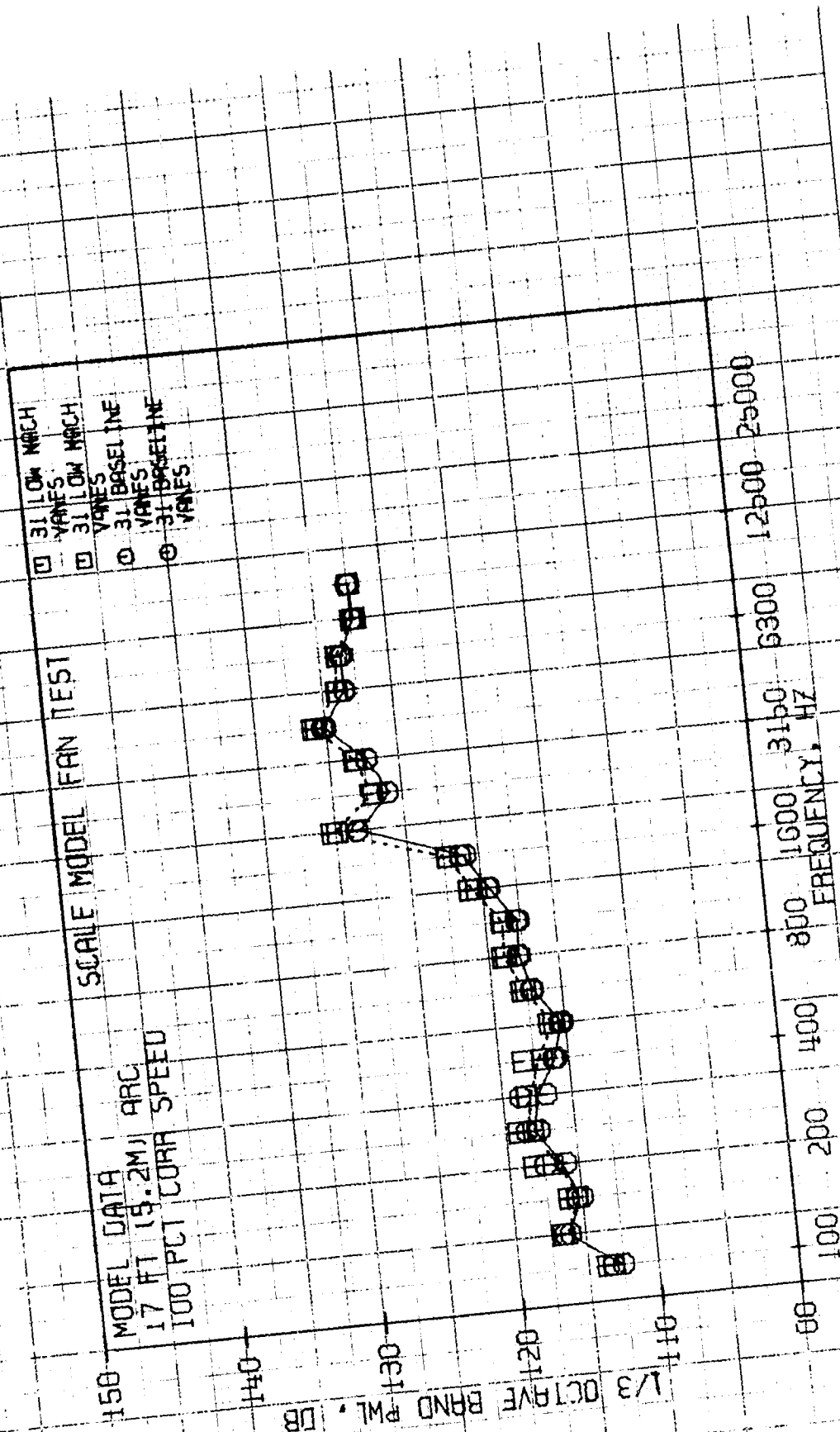


FIGURE 39



ORIGINAL PAGE IS  
OF POOR QUALITY

FIGURE 40

79511 PERT

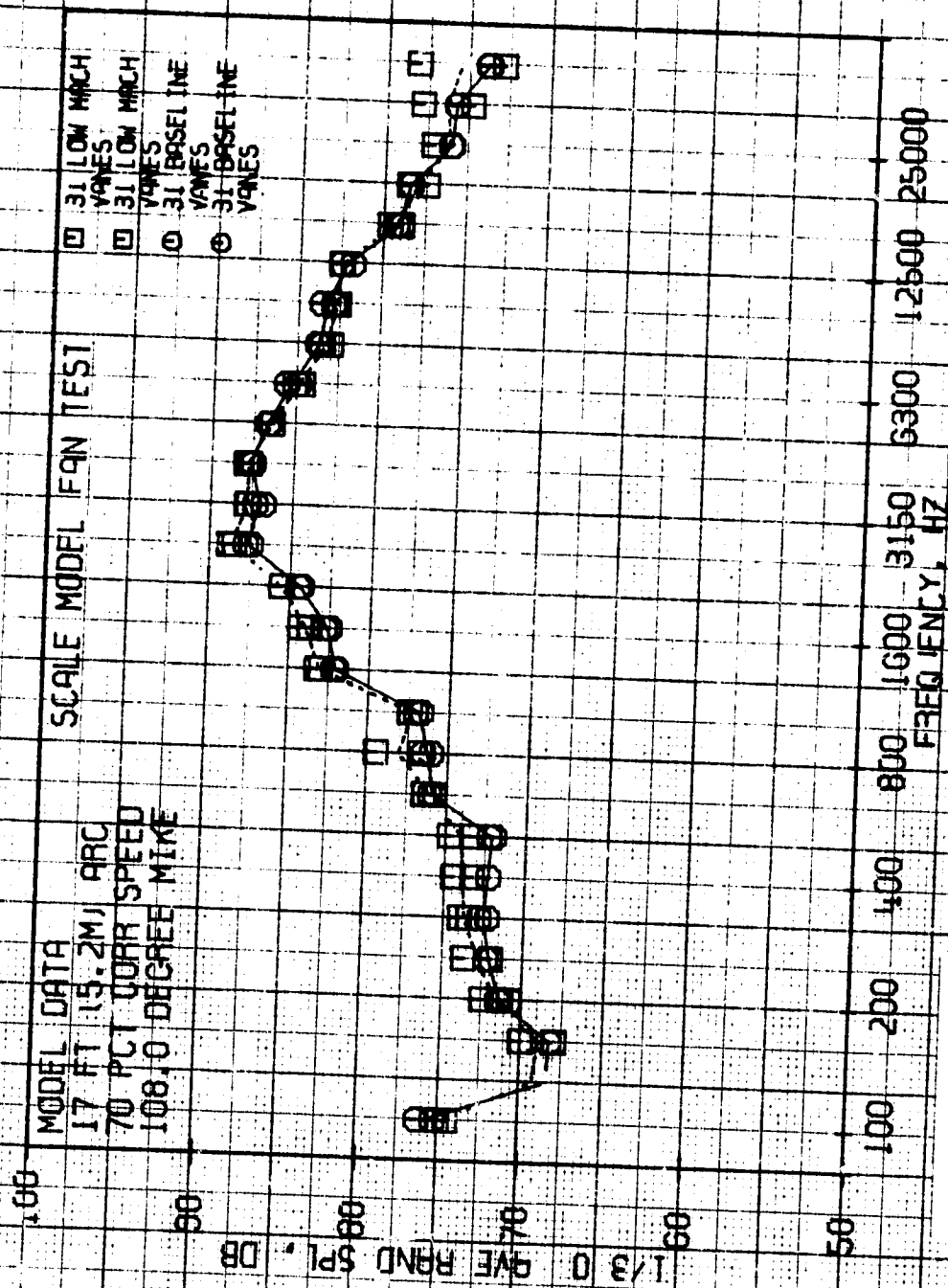


FIGURE 41



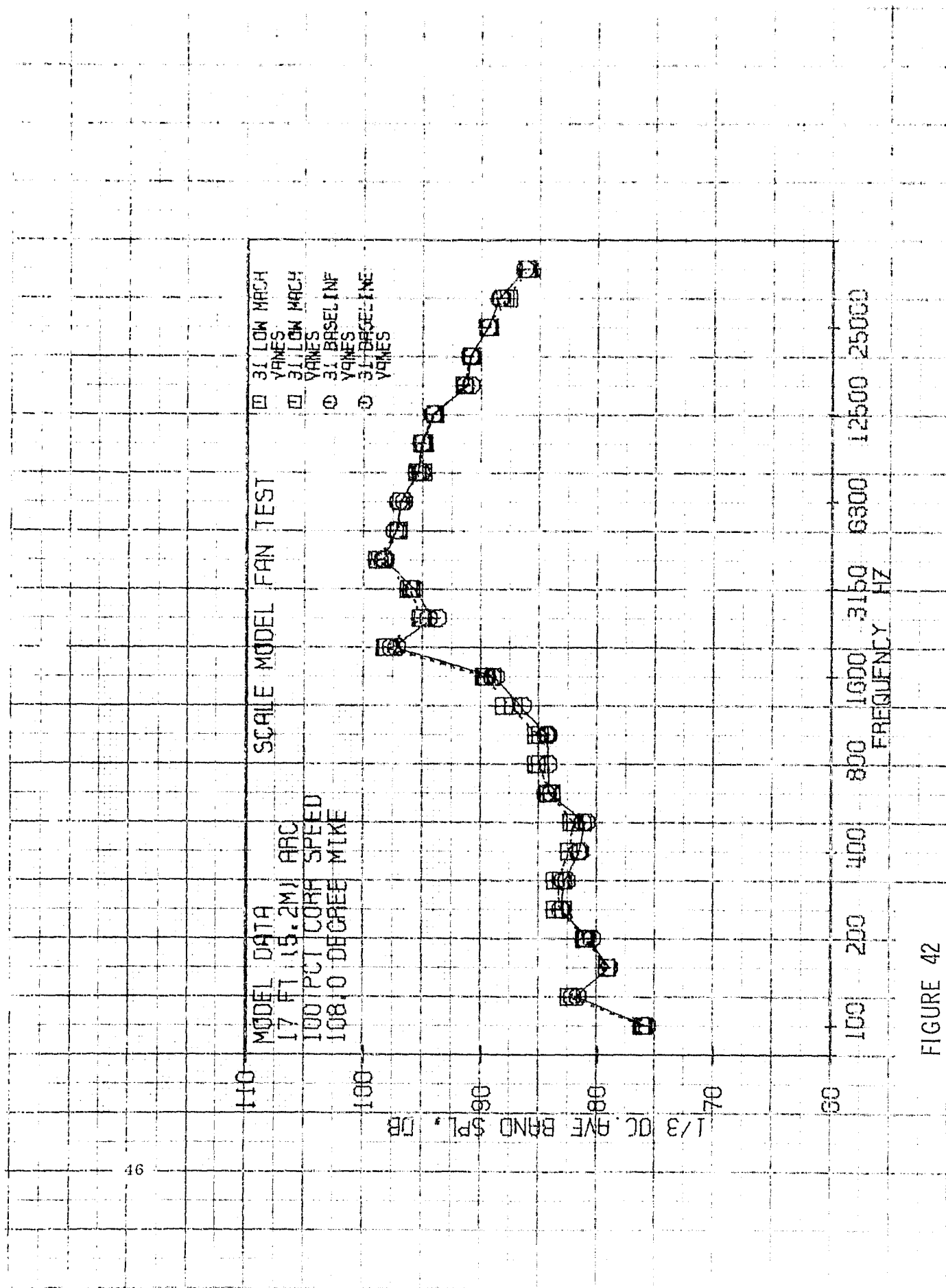


FIGURE 42

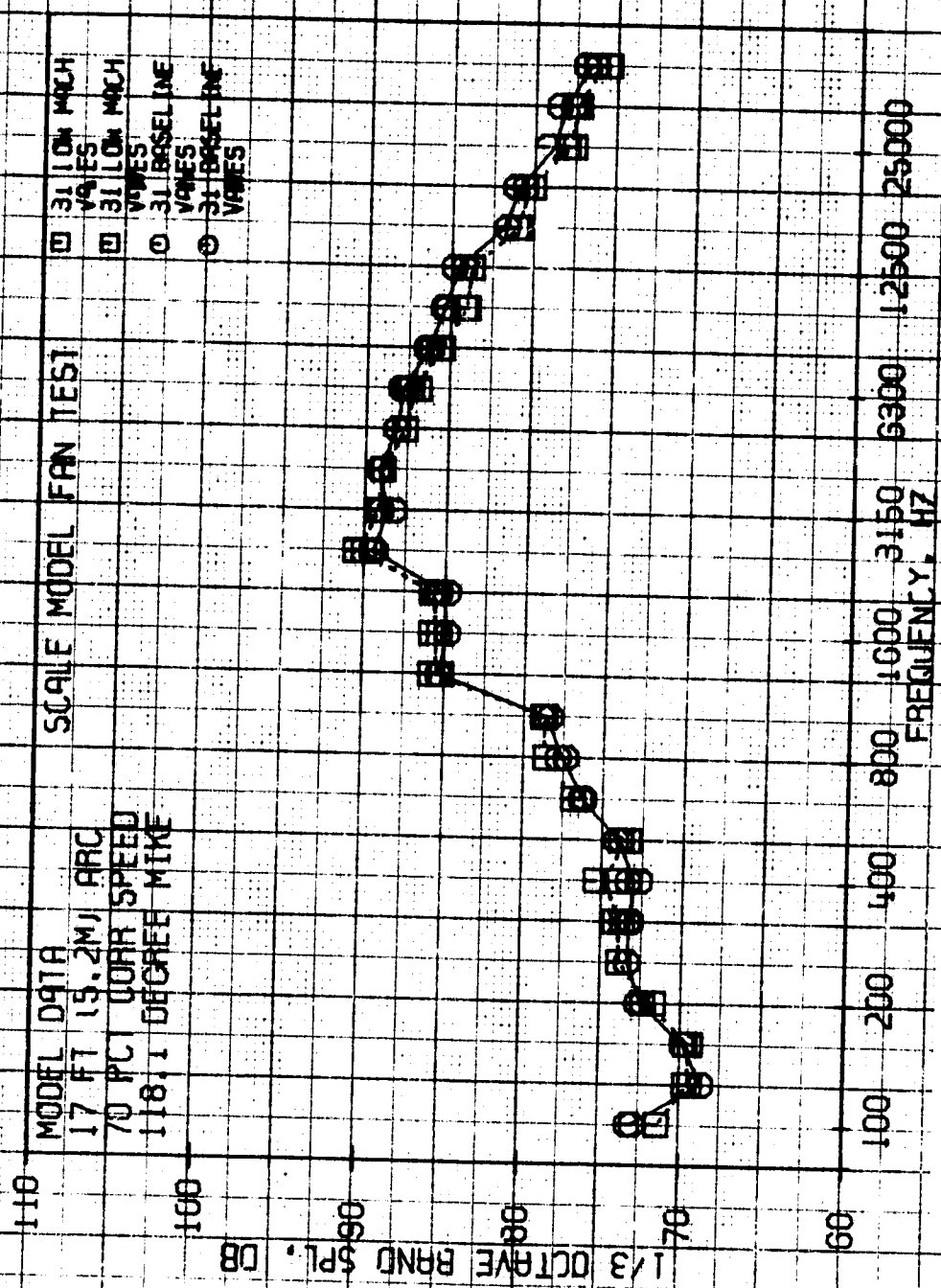


FIGURE 43

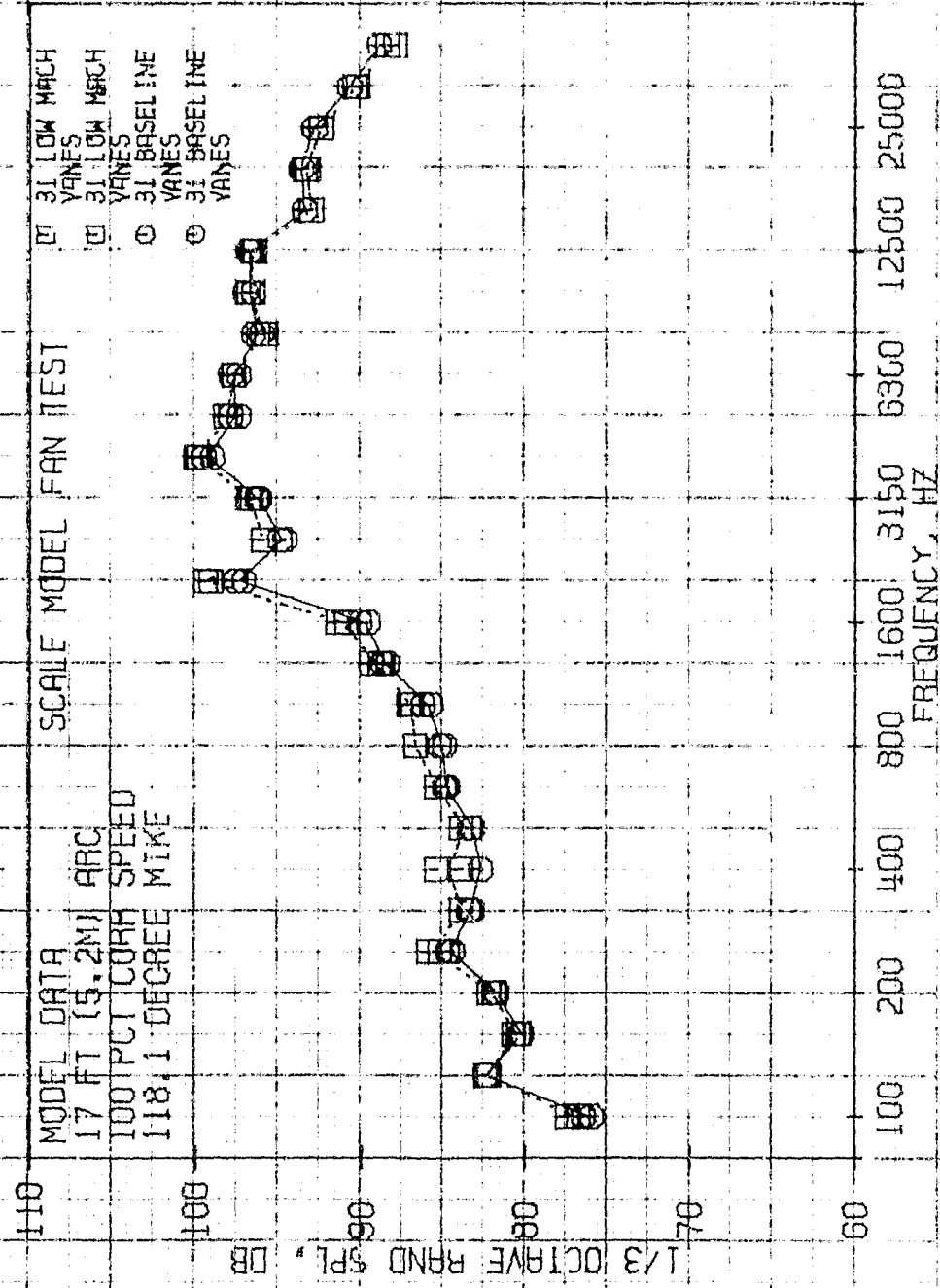


FIGURE 44

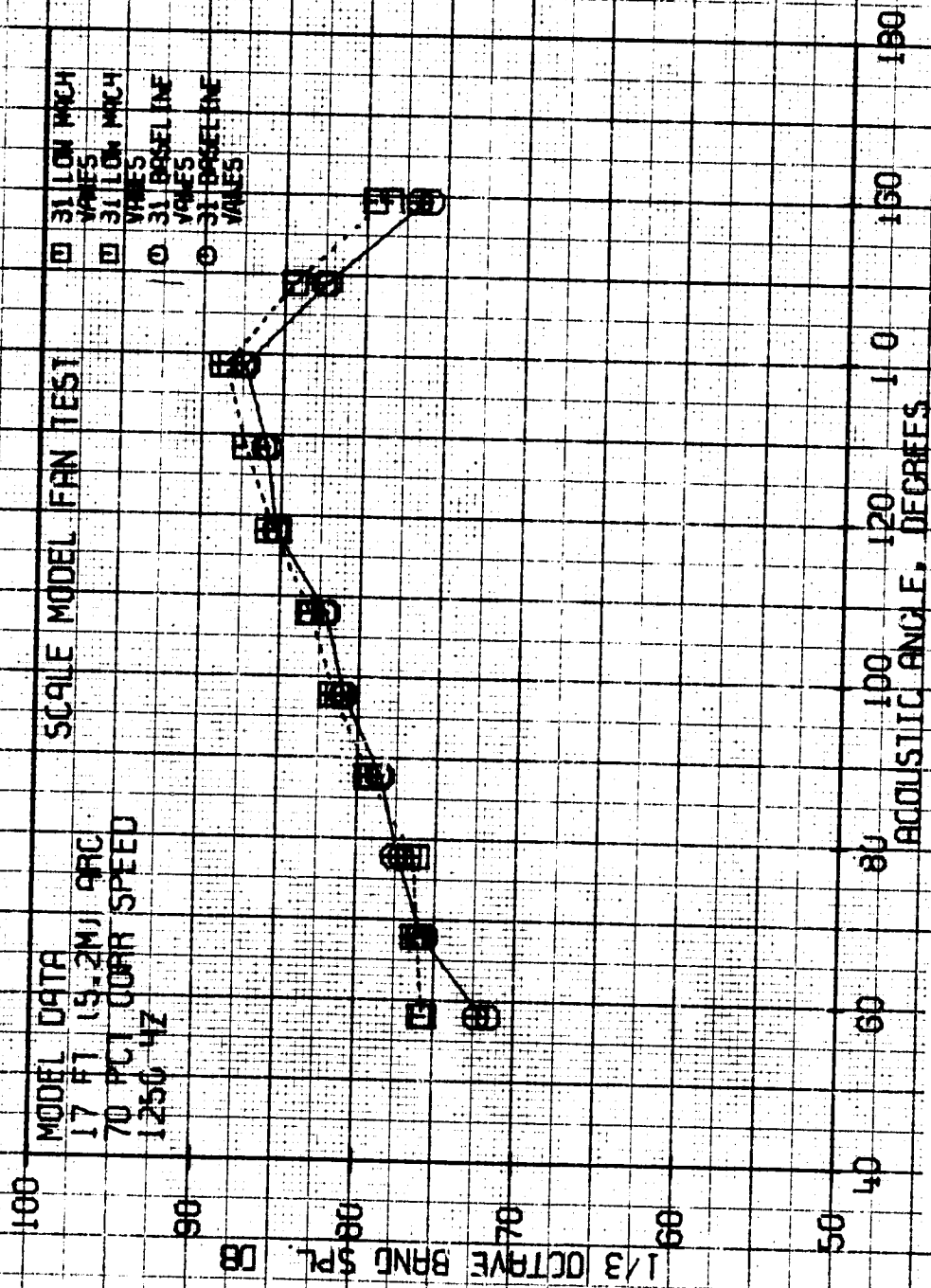


FIGURE 45

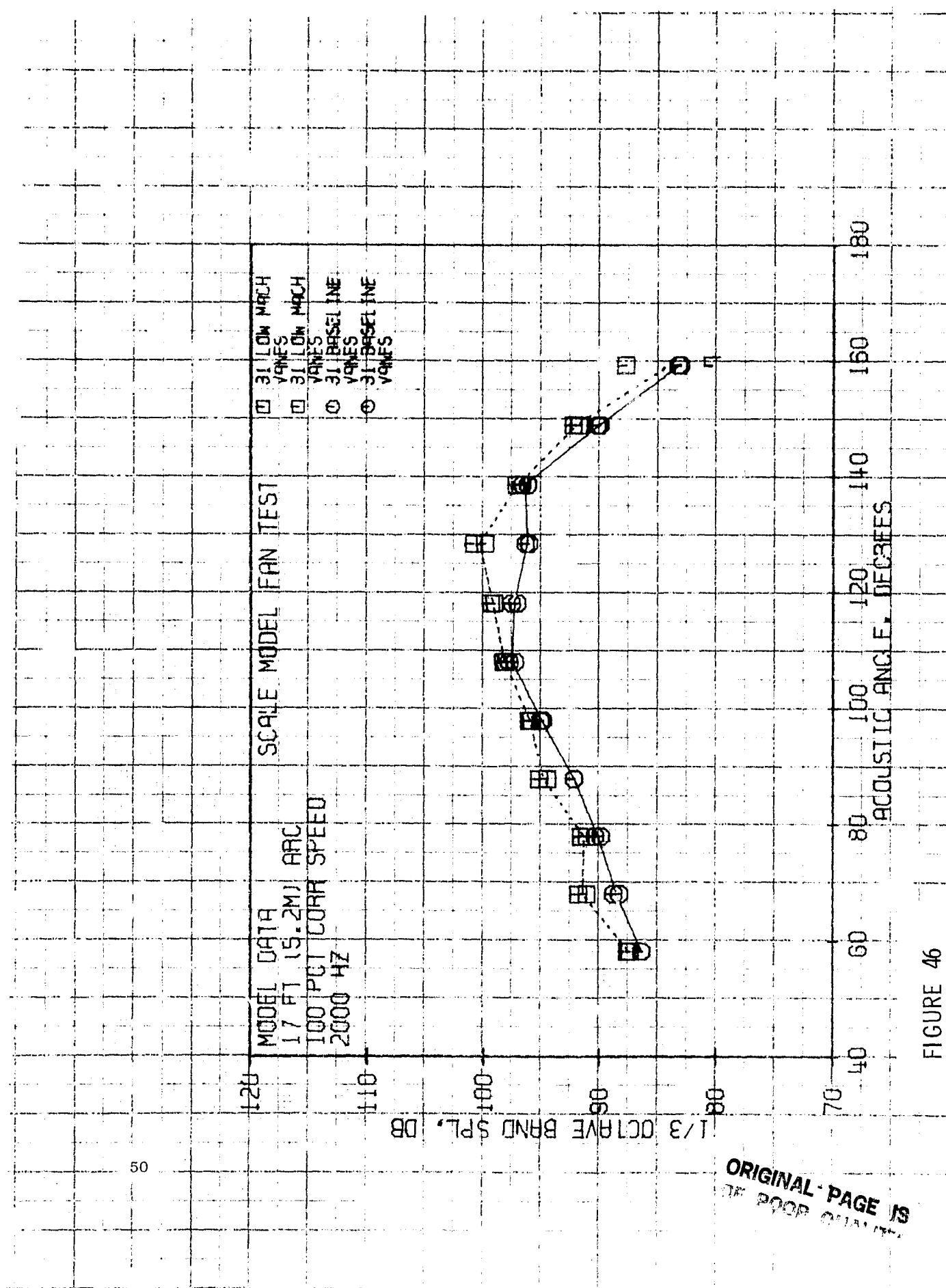


FIGURE 46

ORIGINAL - PAGE 13  
OF 2000

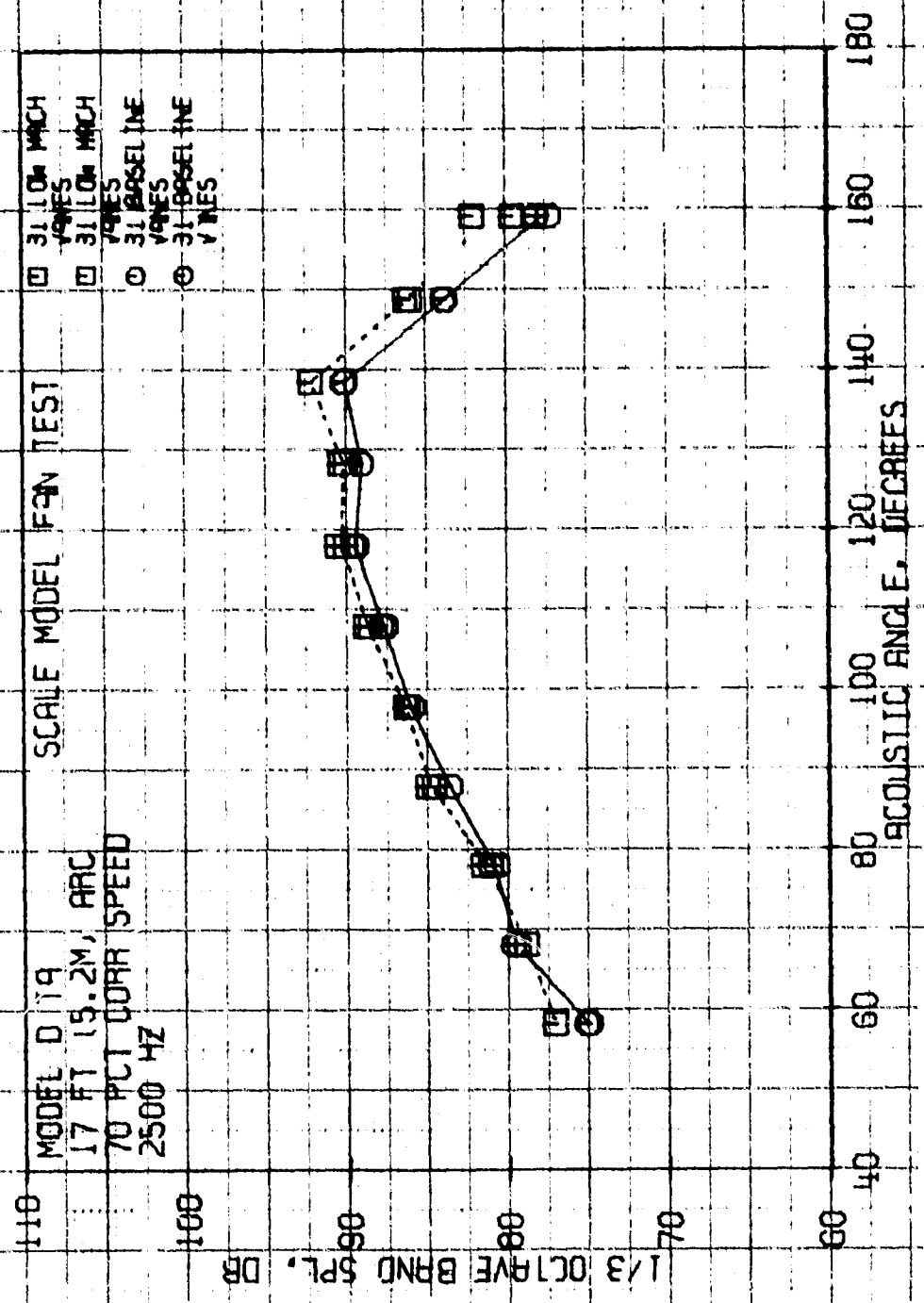


FIGURE 47

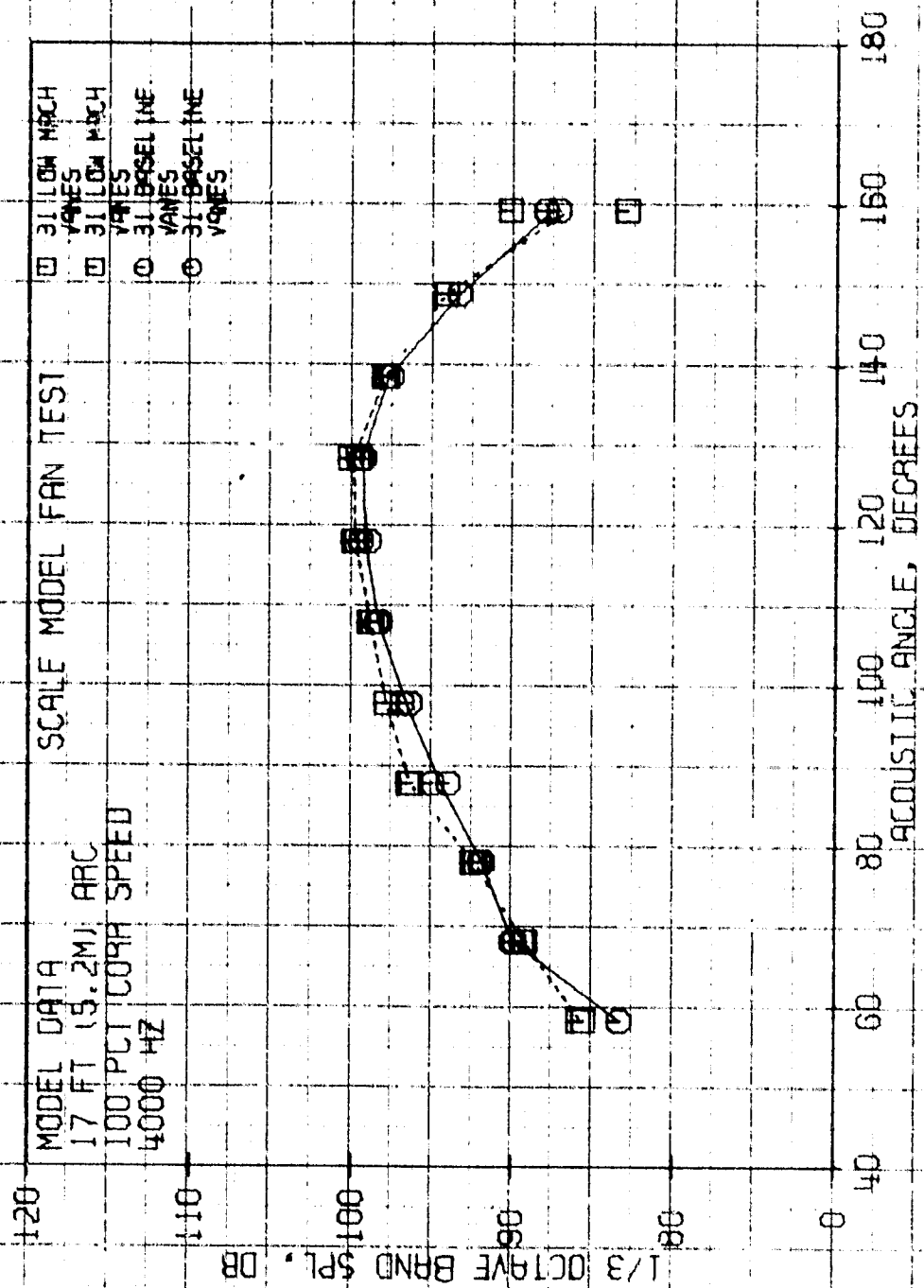


FIGURE 48

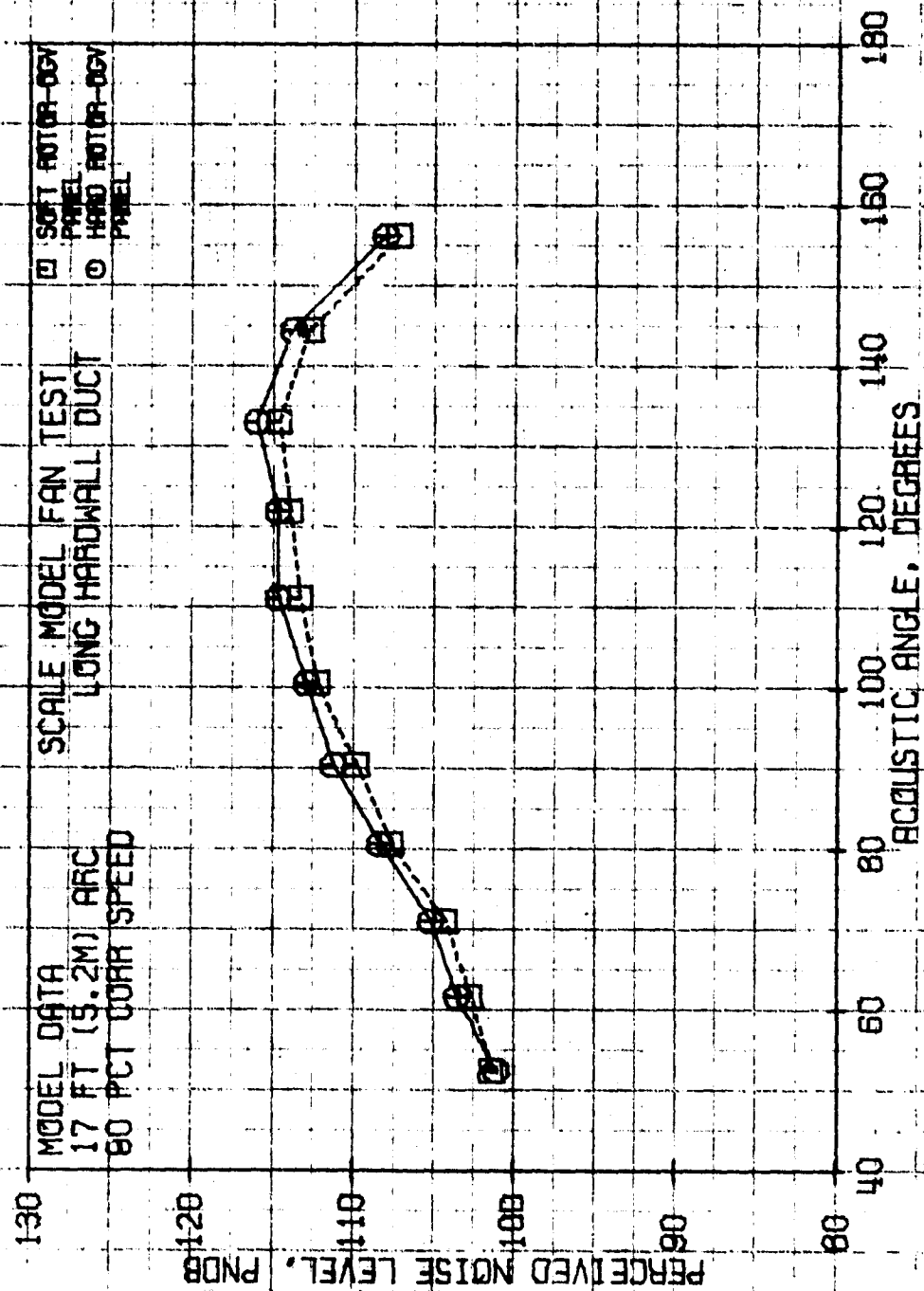


FIGURE 49



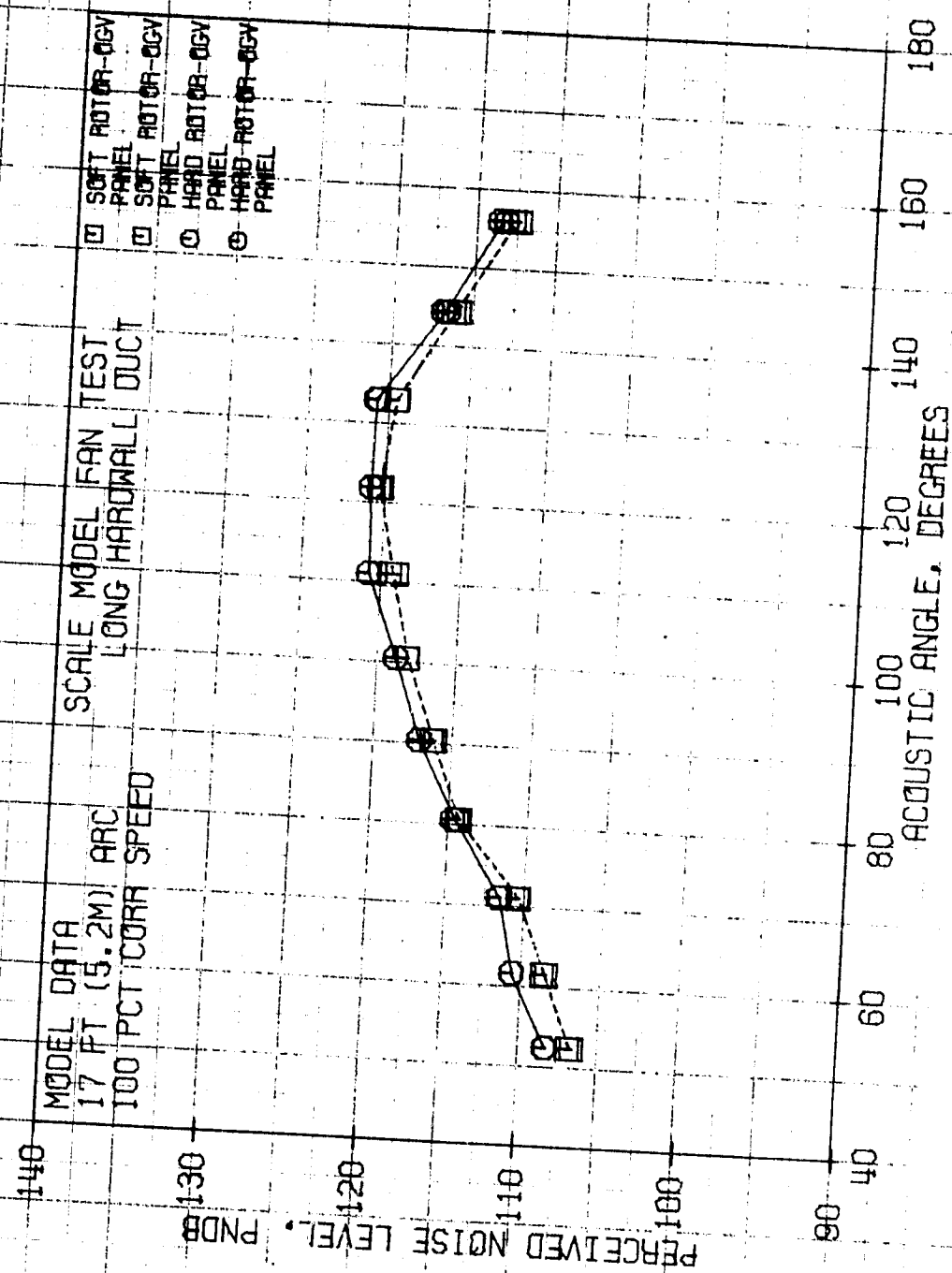


FIGURE 50

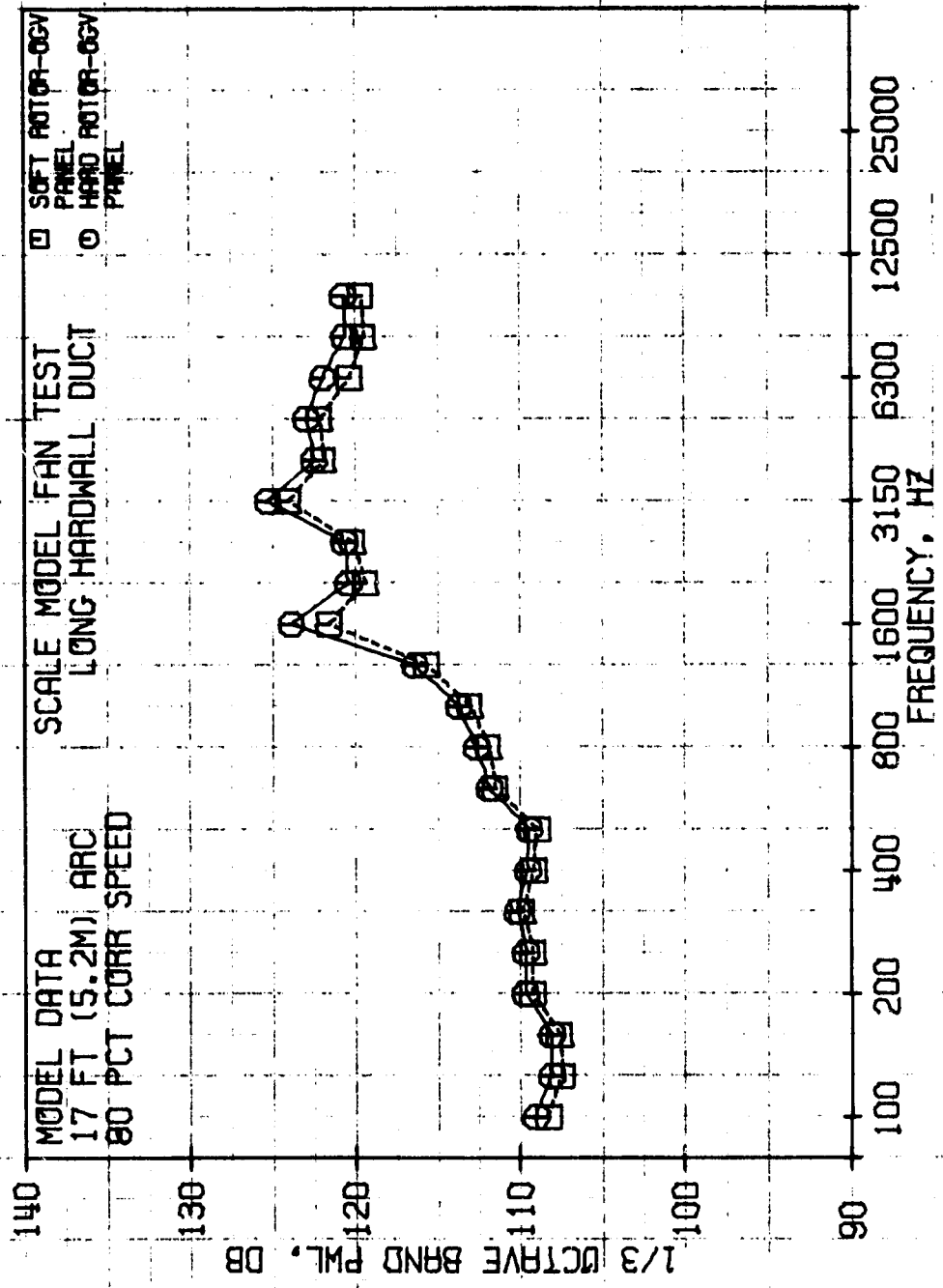


FIGURE 51

ORIGINAL PAGE 1  
OF FOUR

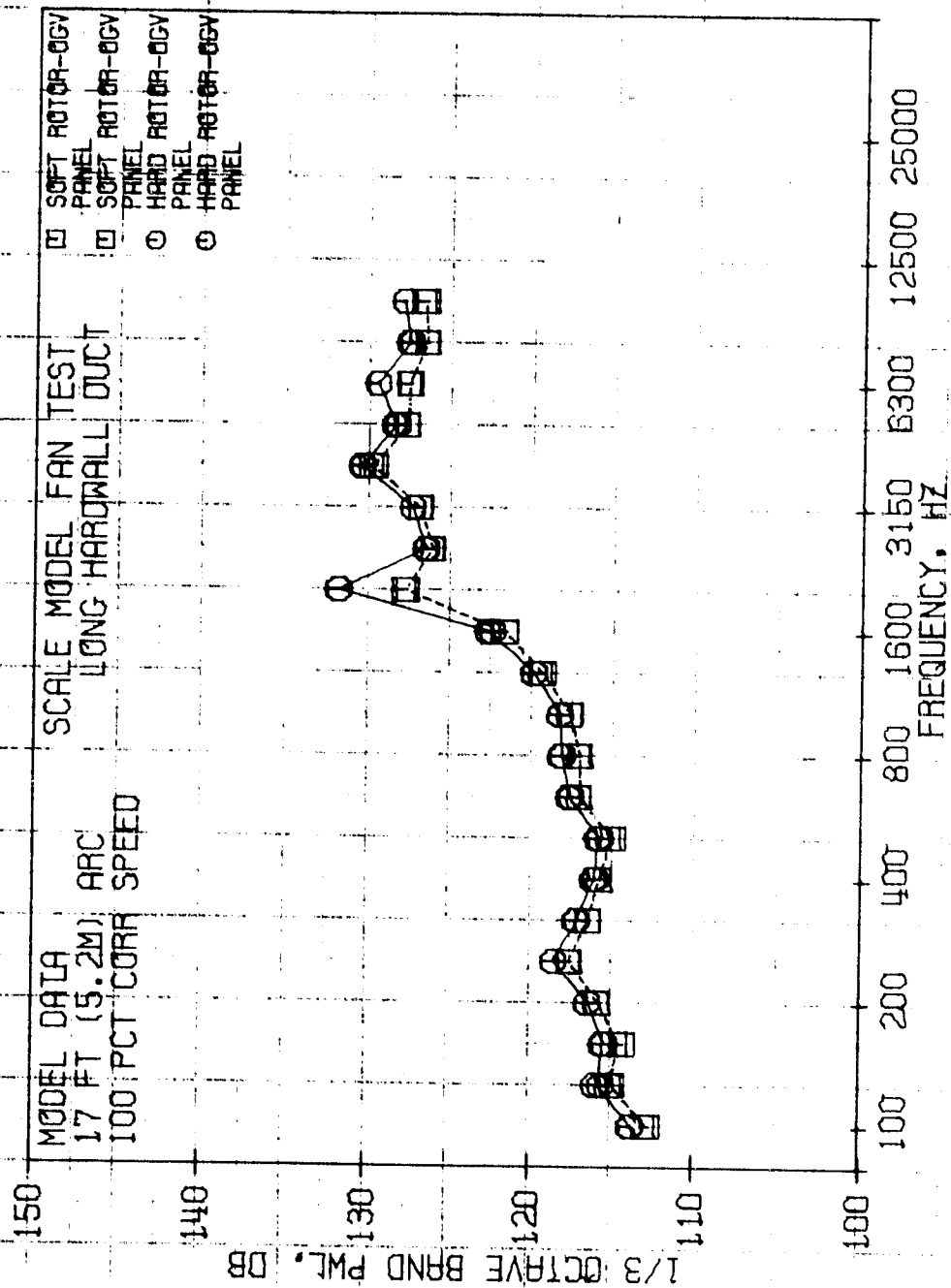


FIGURE 52

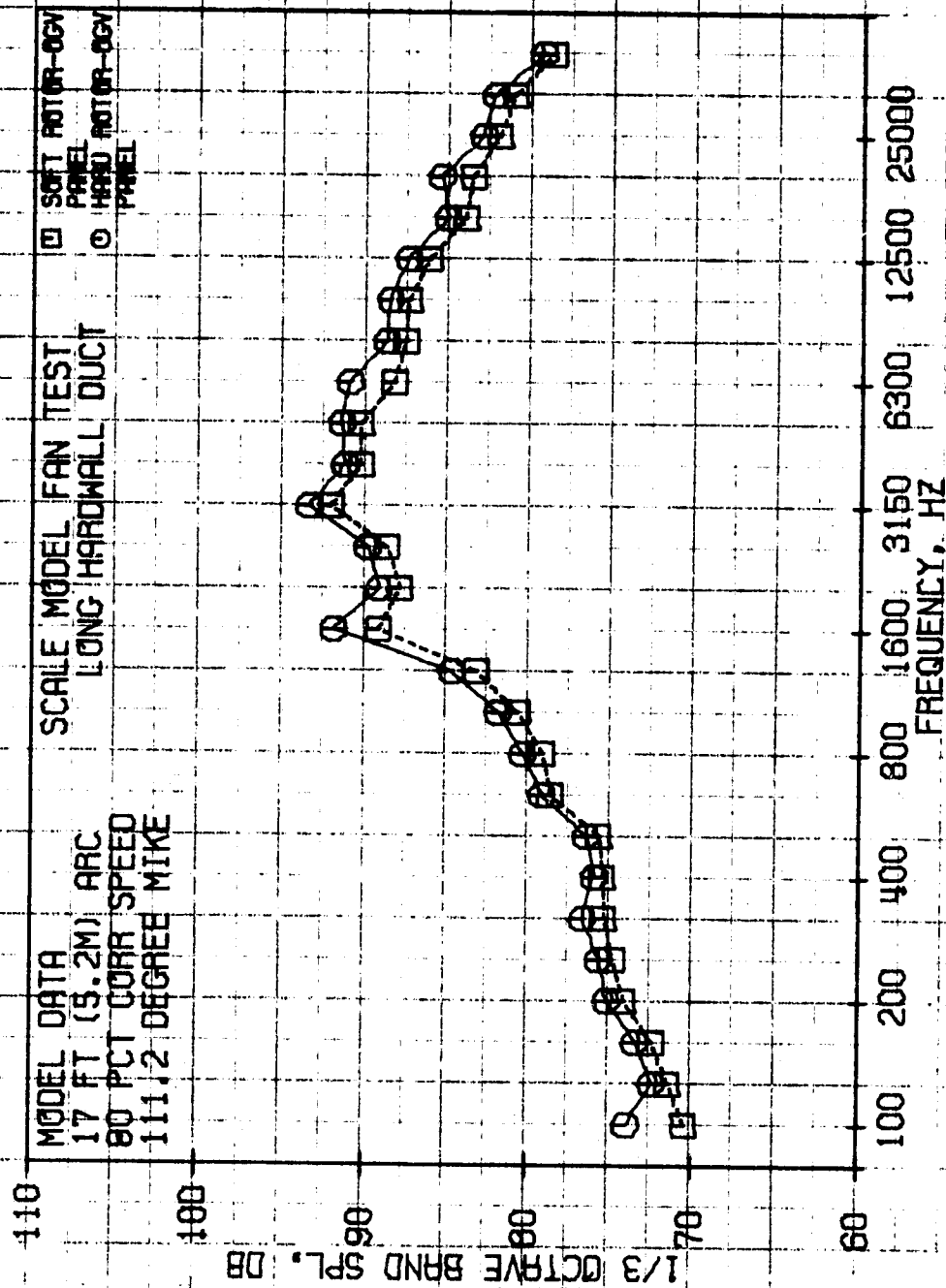


FIGURE 53

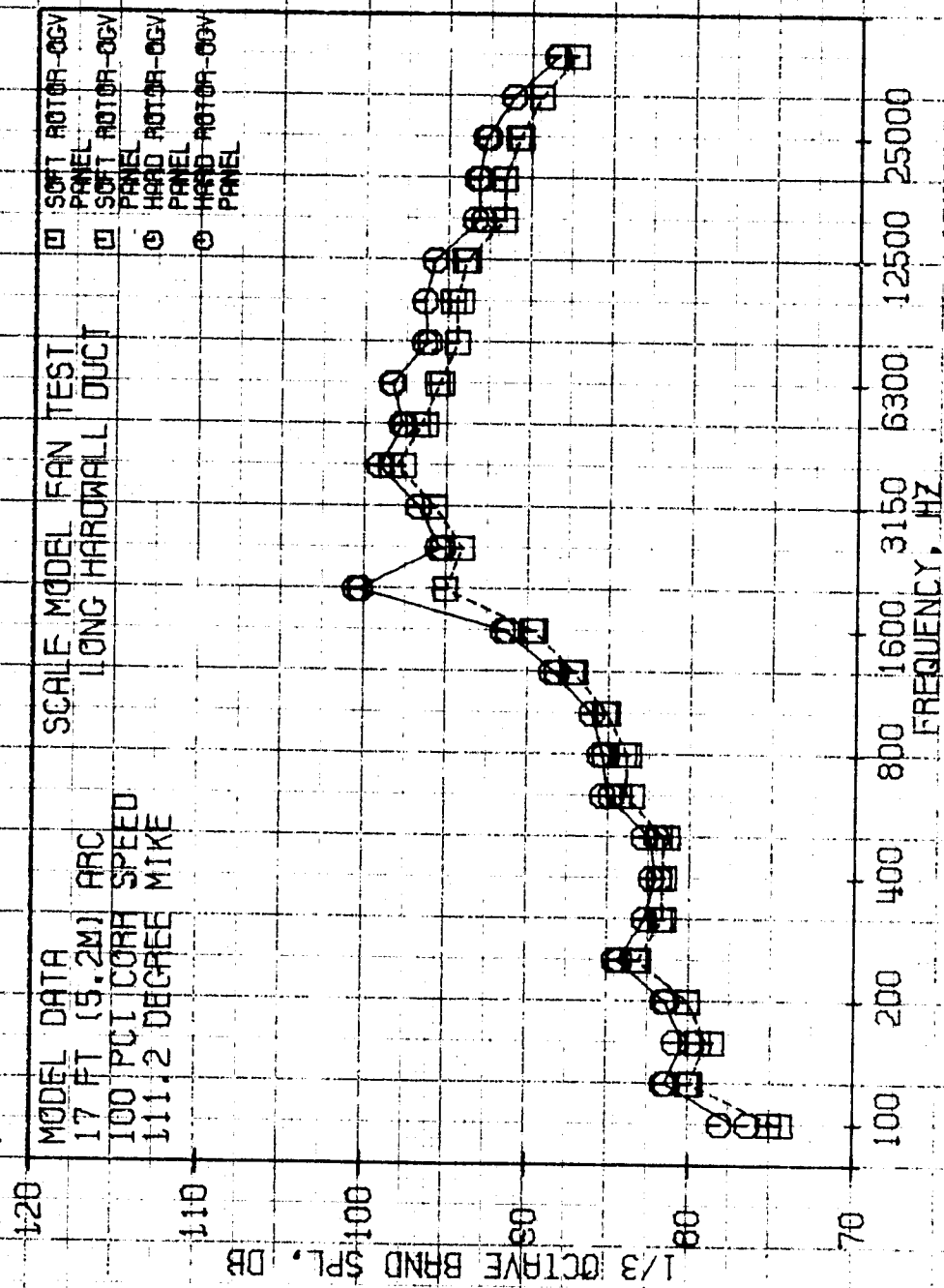


FIGURE 54

ORIGINAL PAGE IS  
OF POOR QUALITY

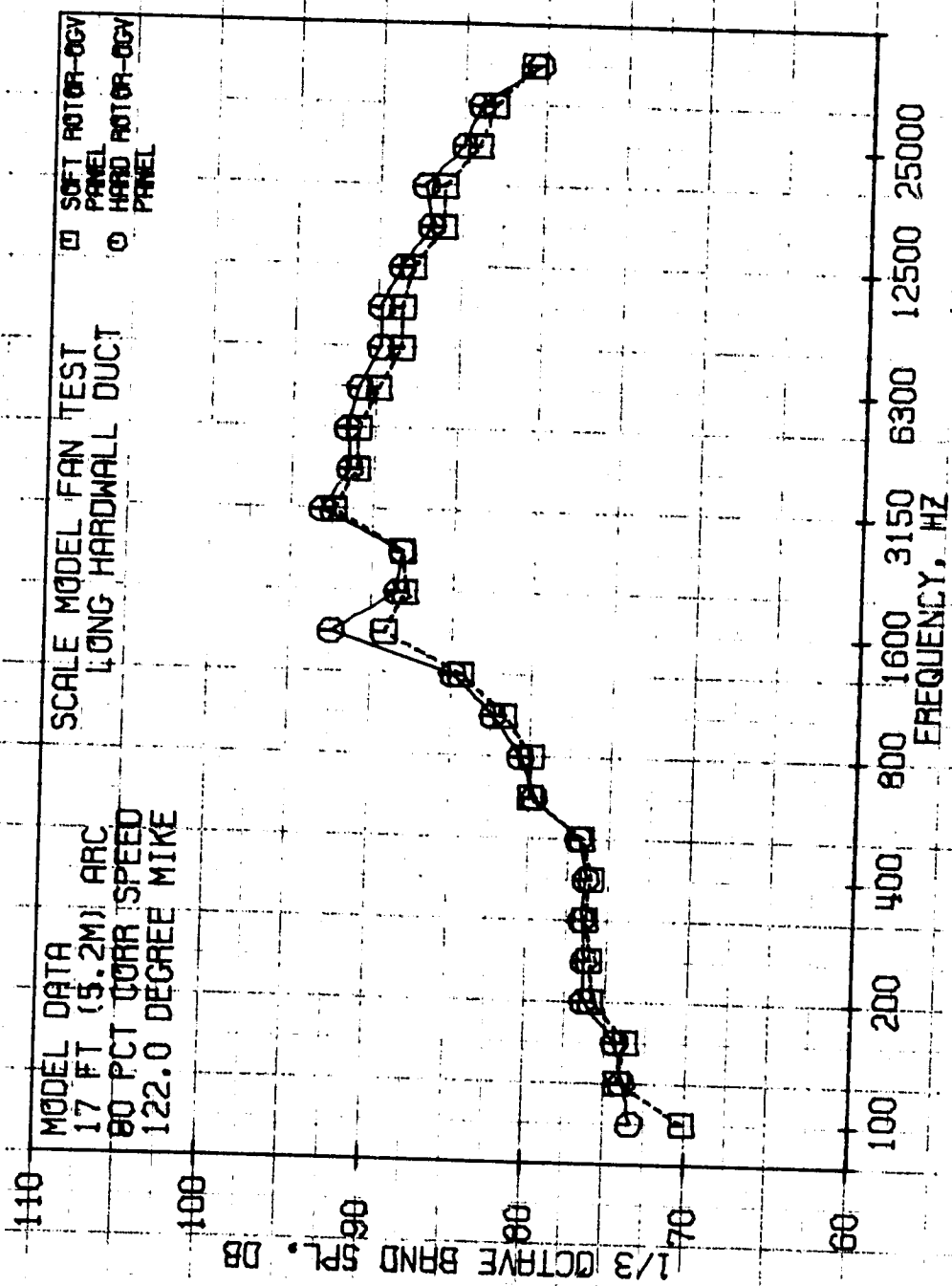


FIGURE 55

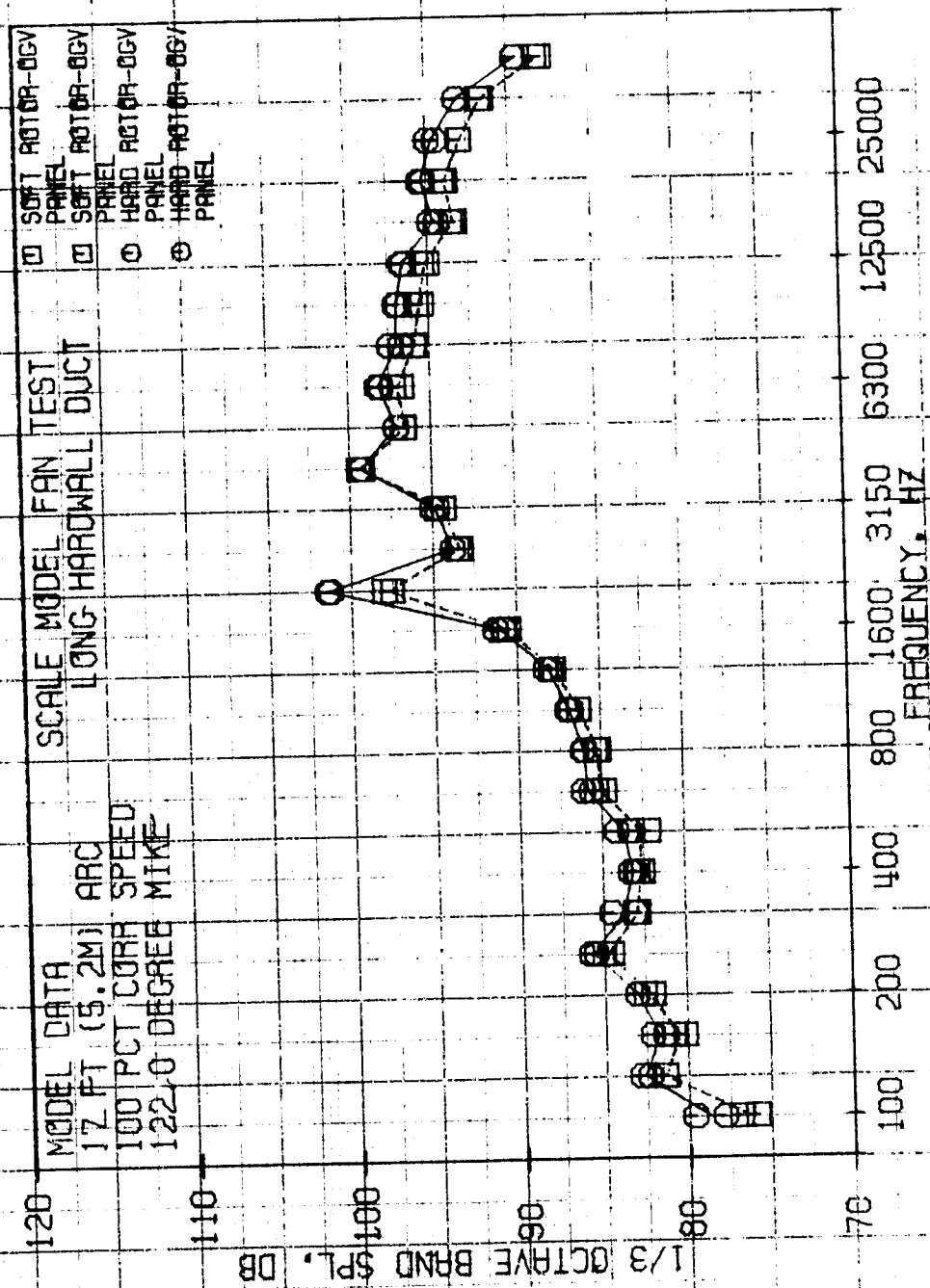


FIGURE 56

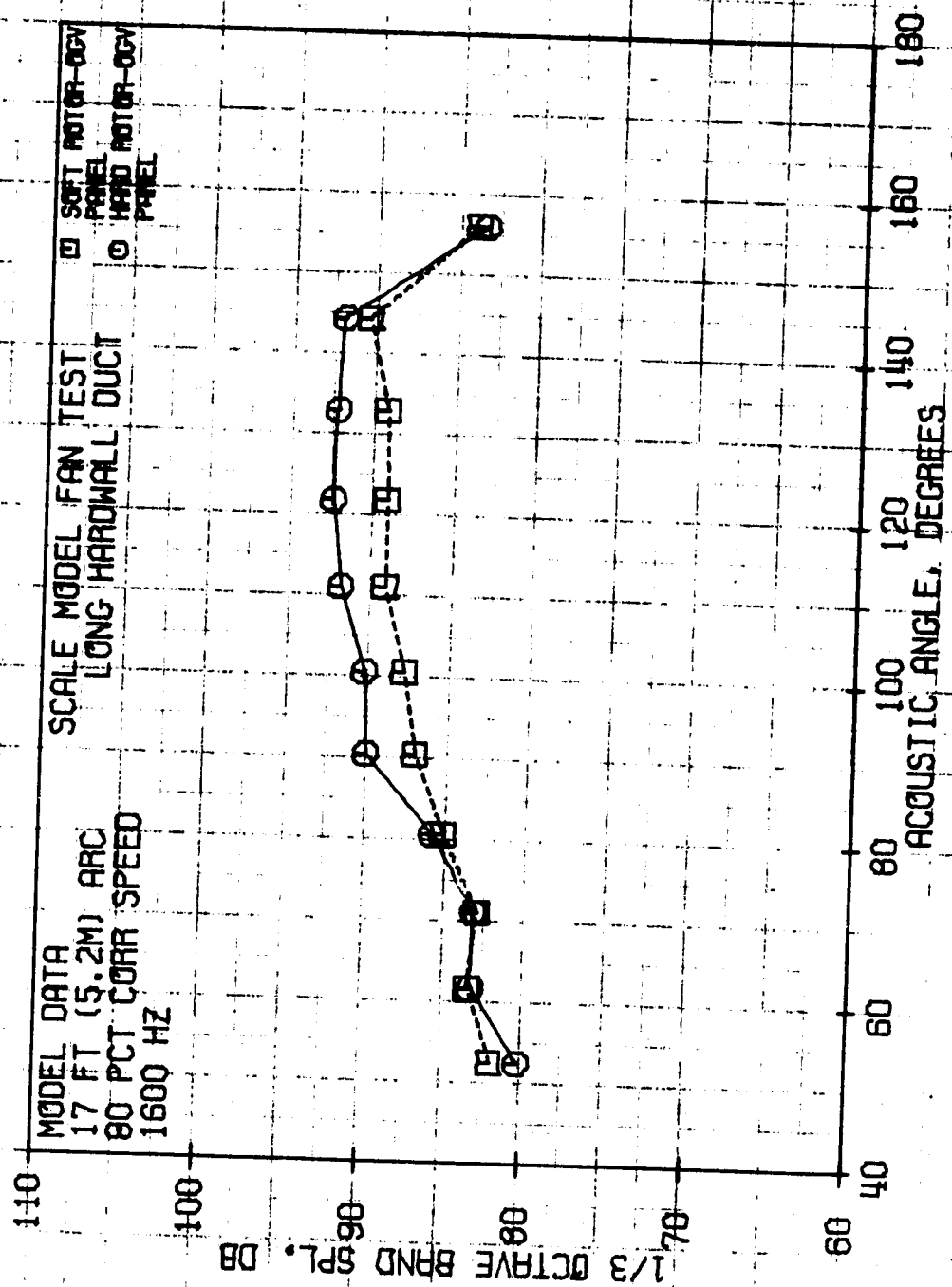


FIGURE 57



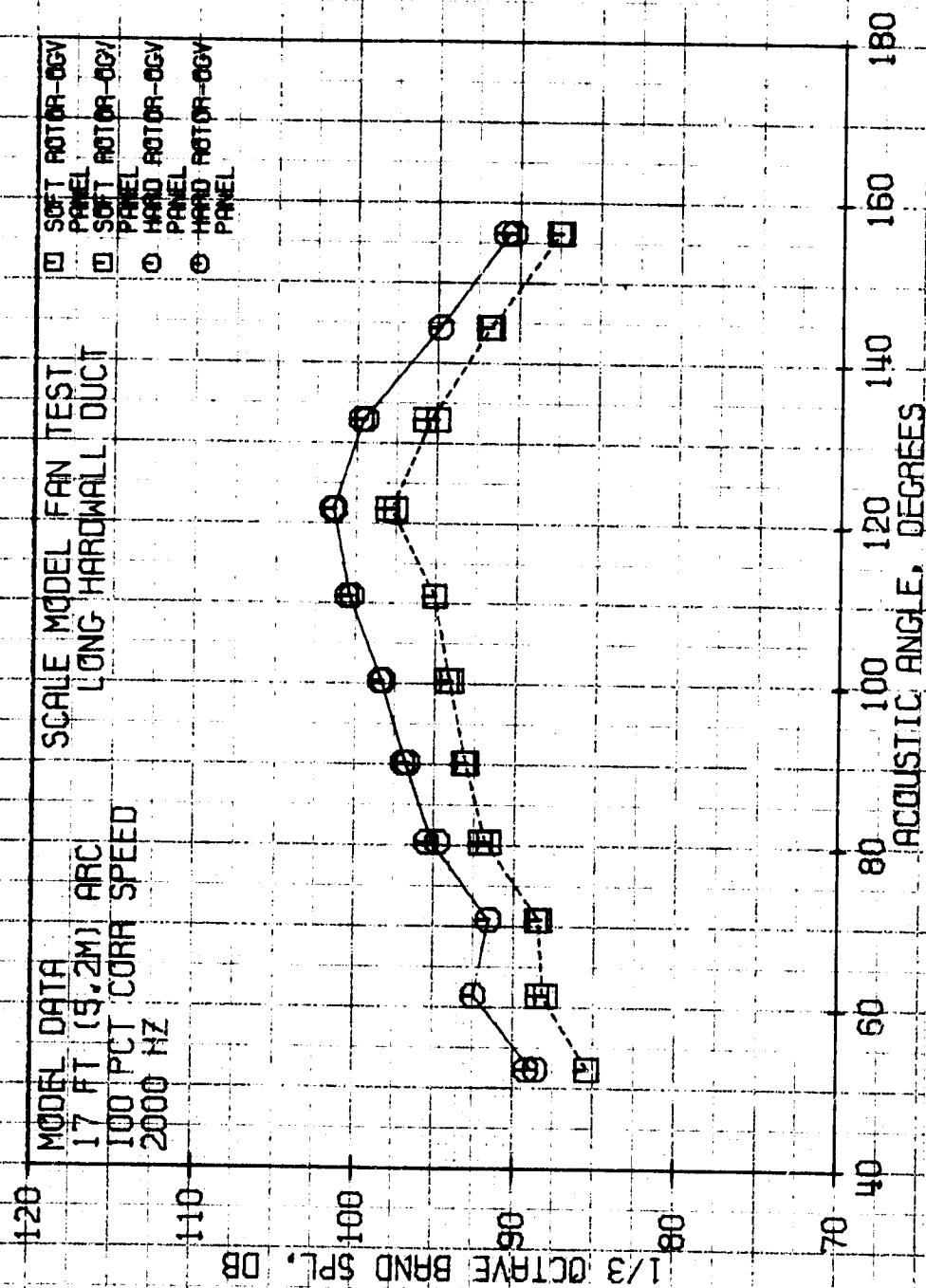


FIGURE 58

ORIGINAL PAGE IS  
OF POOR QUALITY

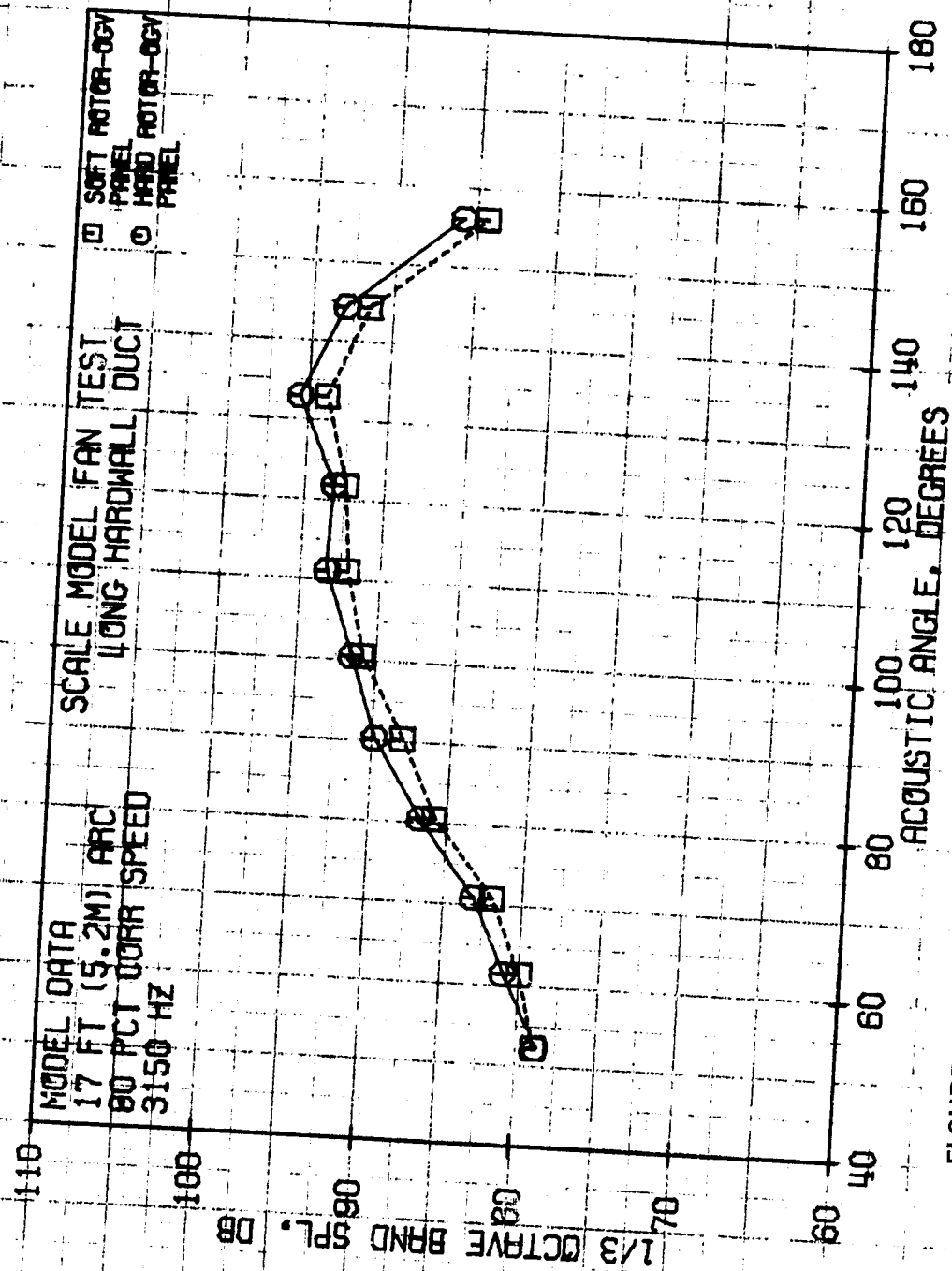


FIGURE 59

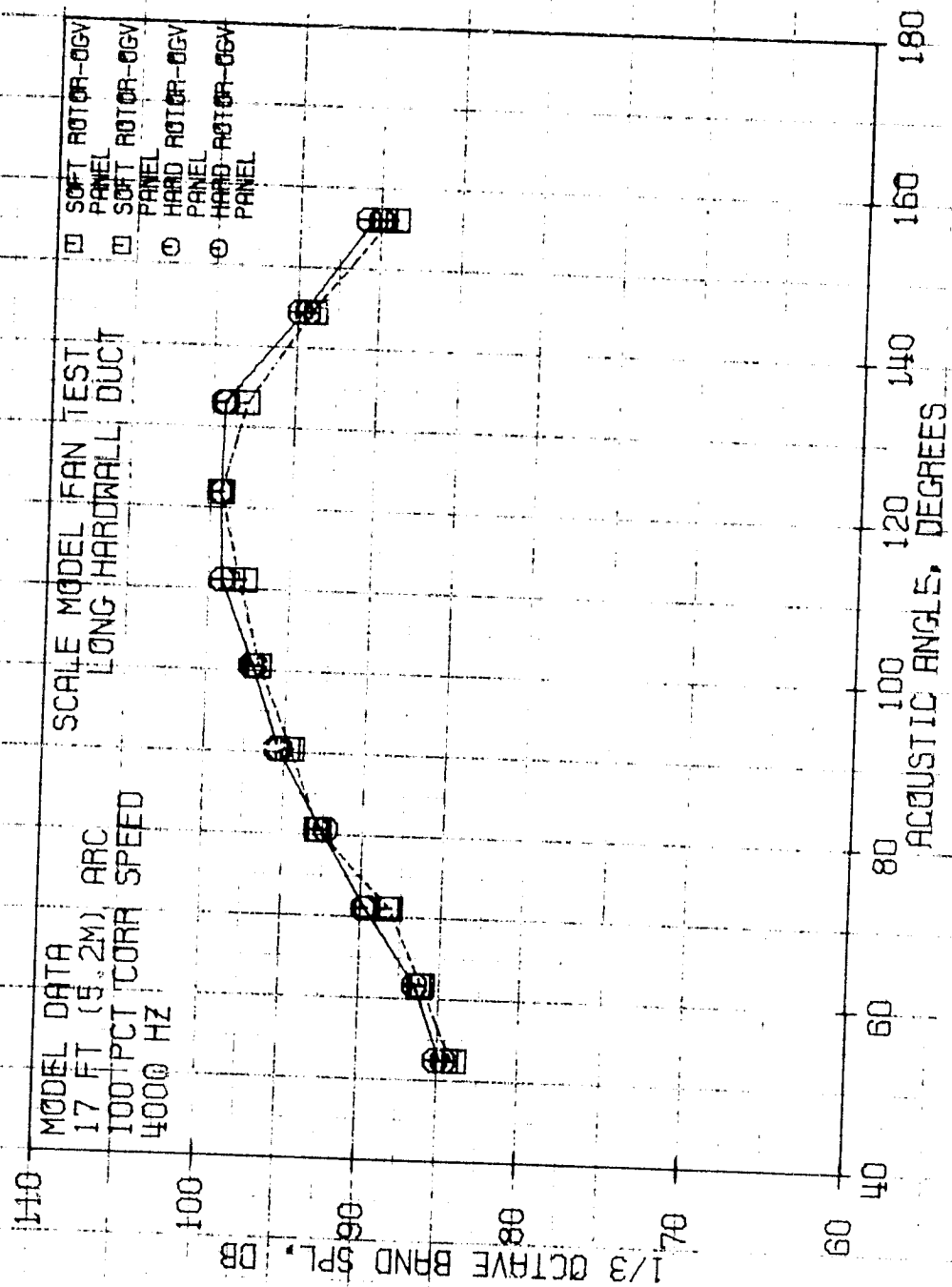
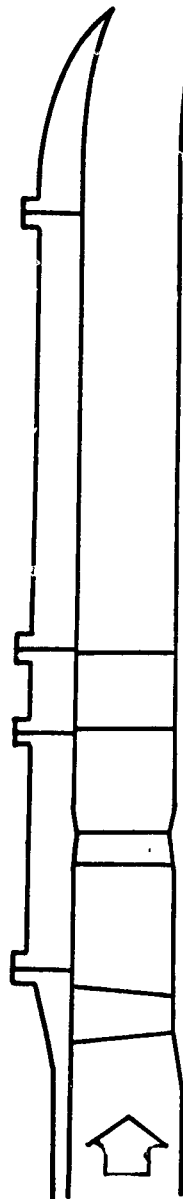
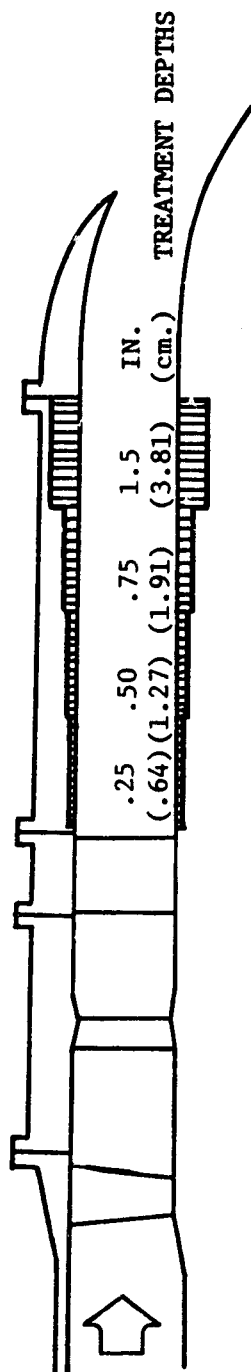


FIGURE 60

CONFIGURATION 18, BASELINE HARDWALL



CONFIGURATION 7, POROSITY = 12%



CONFIGURATION 8, POROSITY = 27%

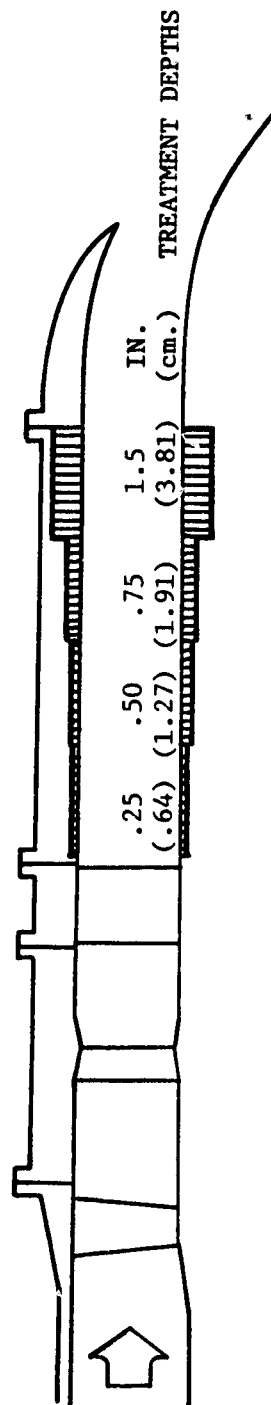


FIGURE 61. POROSITY VARIATION CONFIGURATIONS

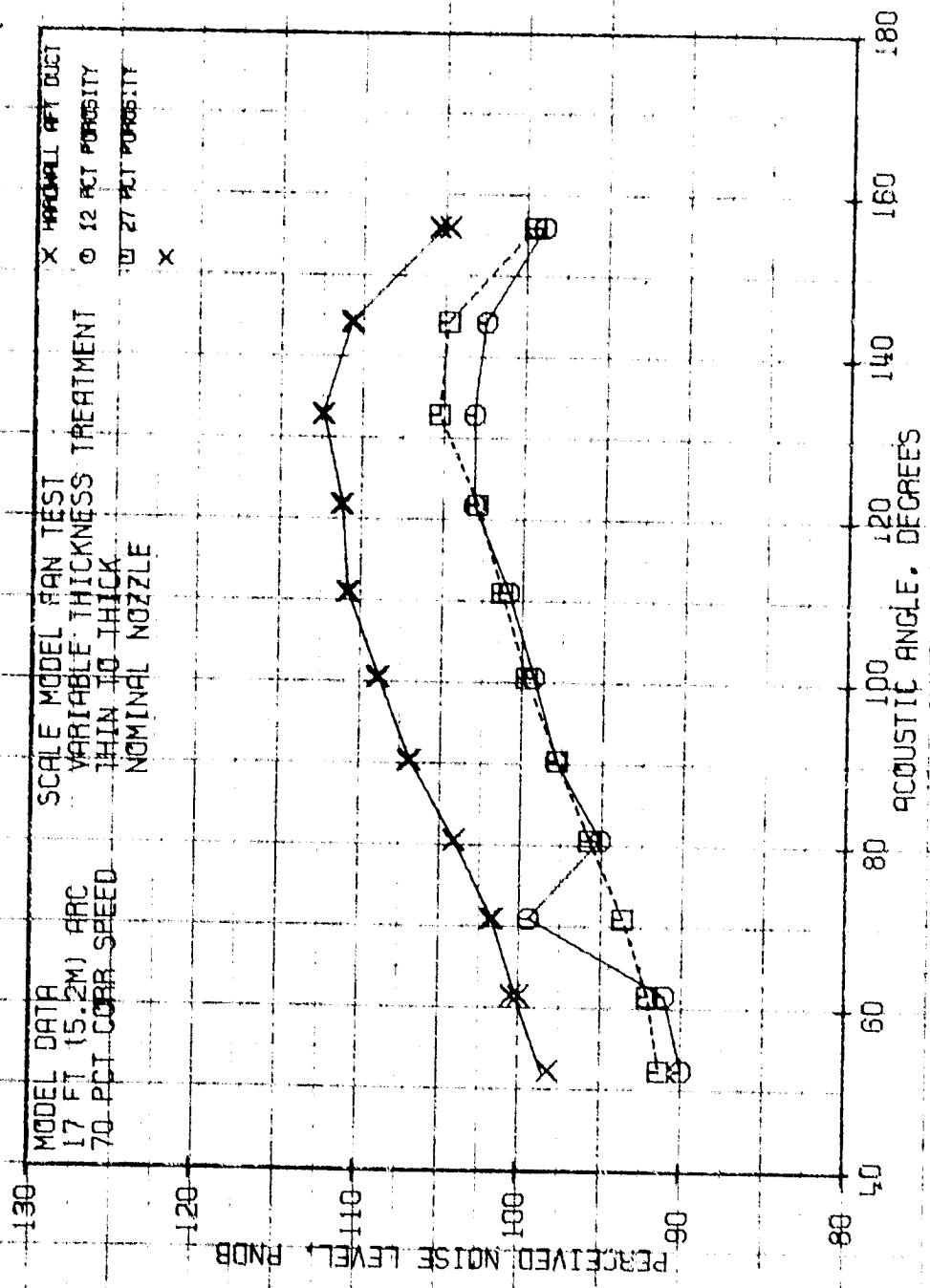


FIGURE 62

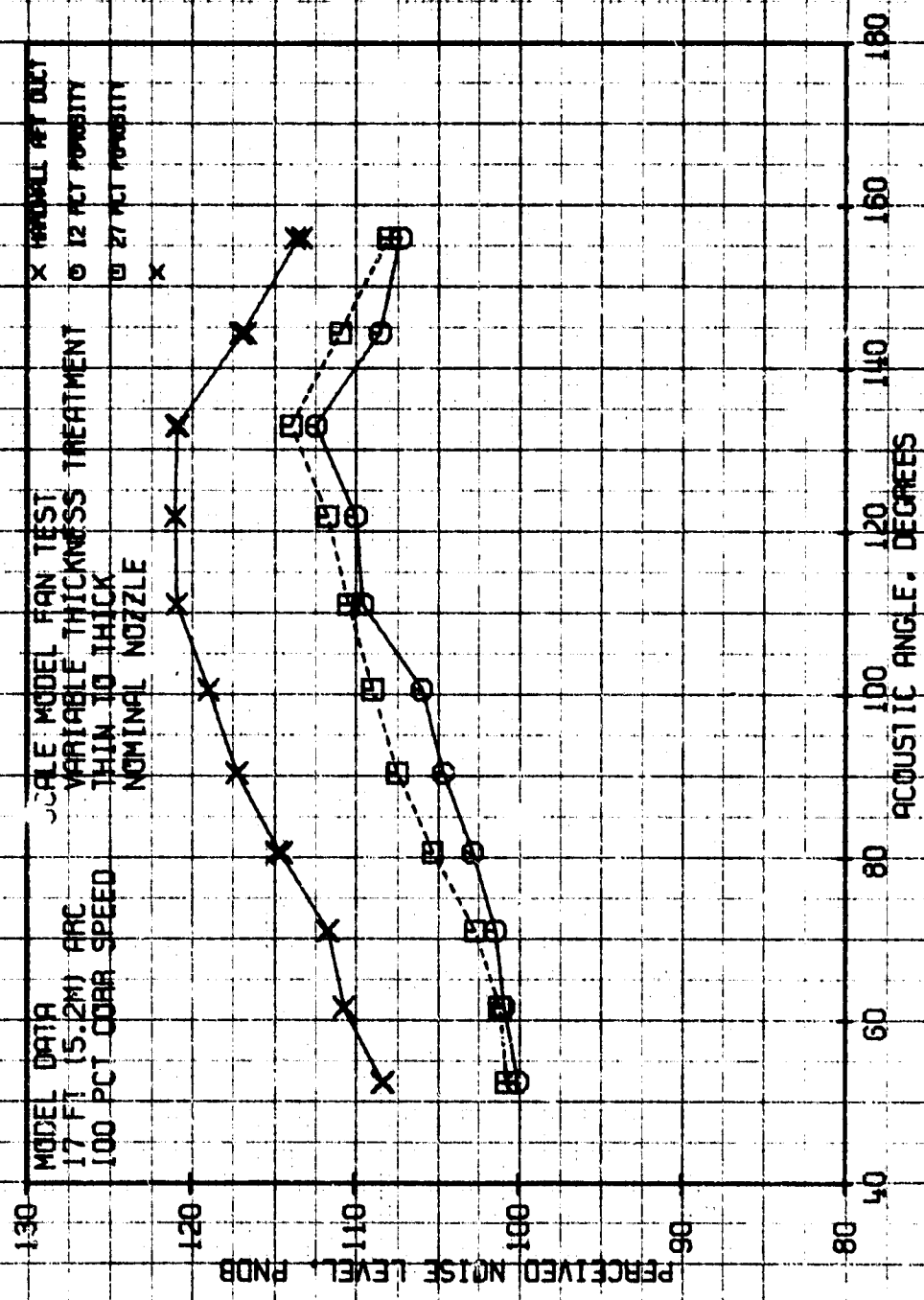


FIGURE 63

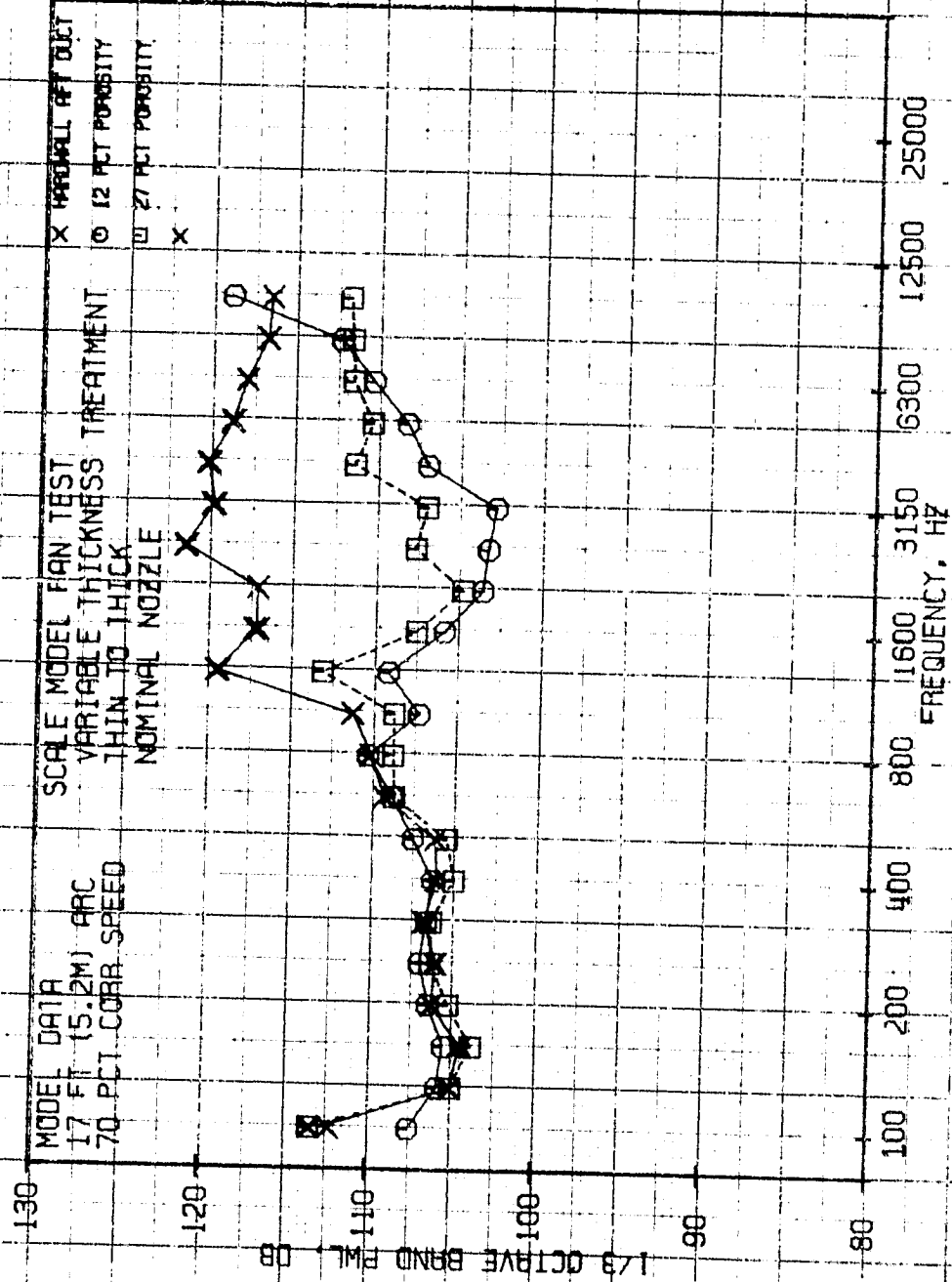


FIGURE 64

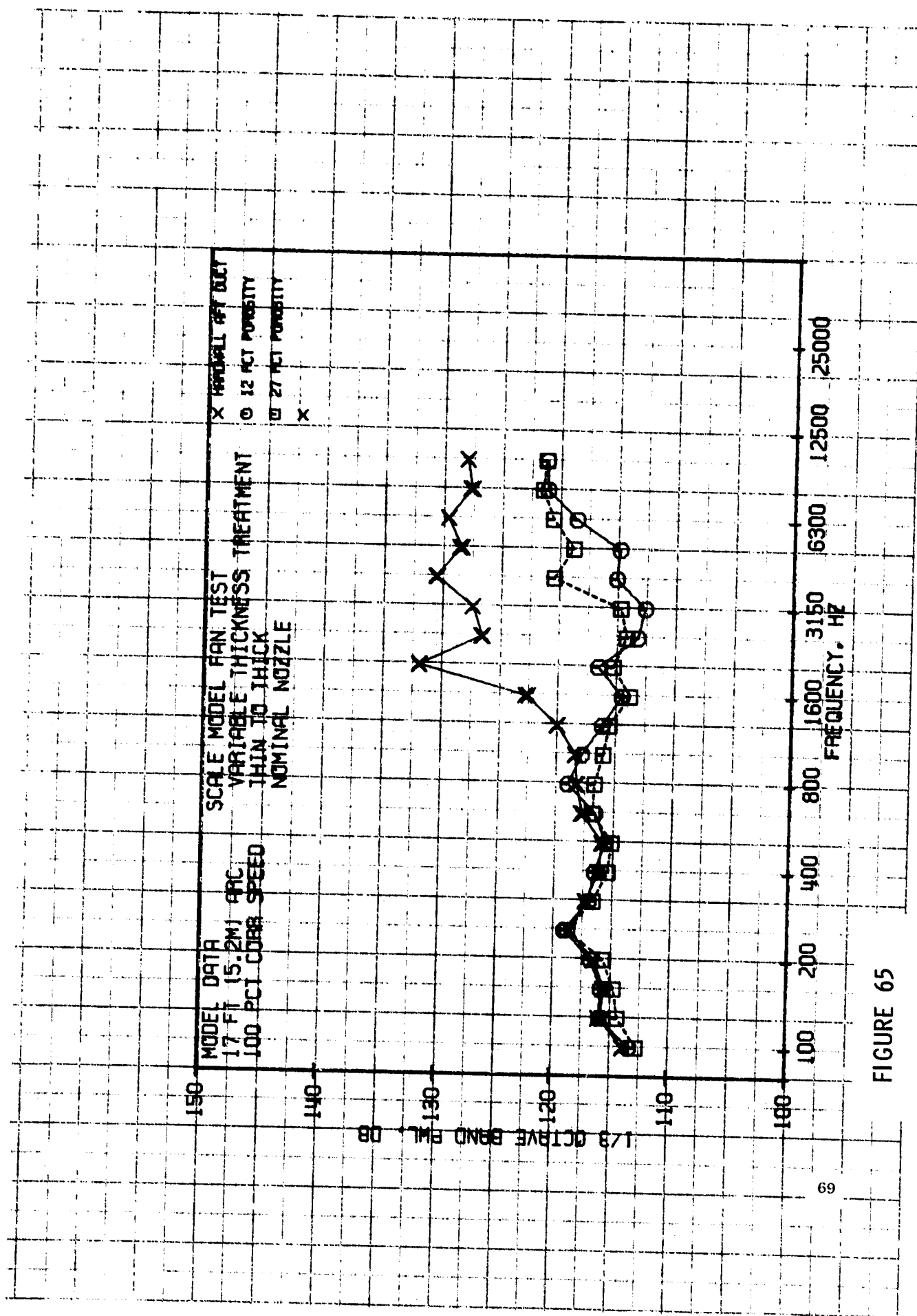


FIGURE 65



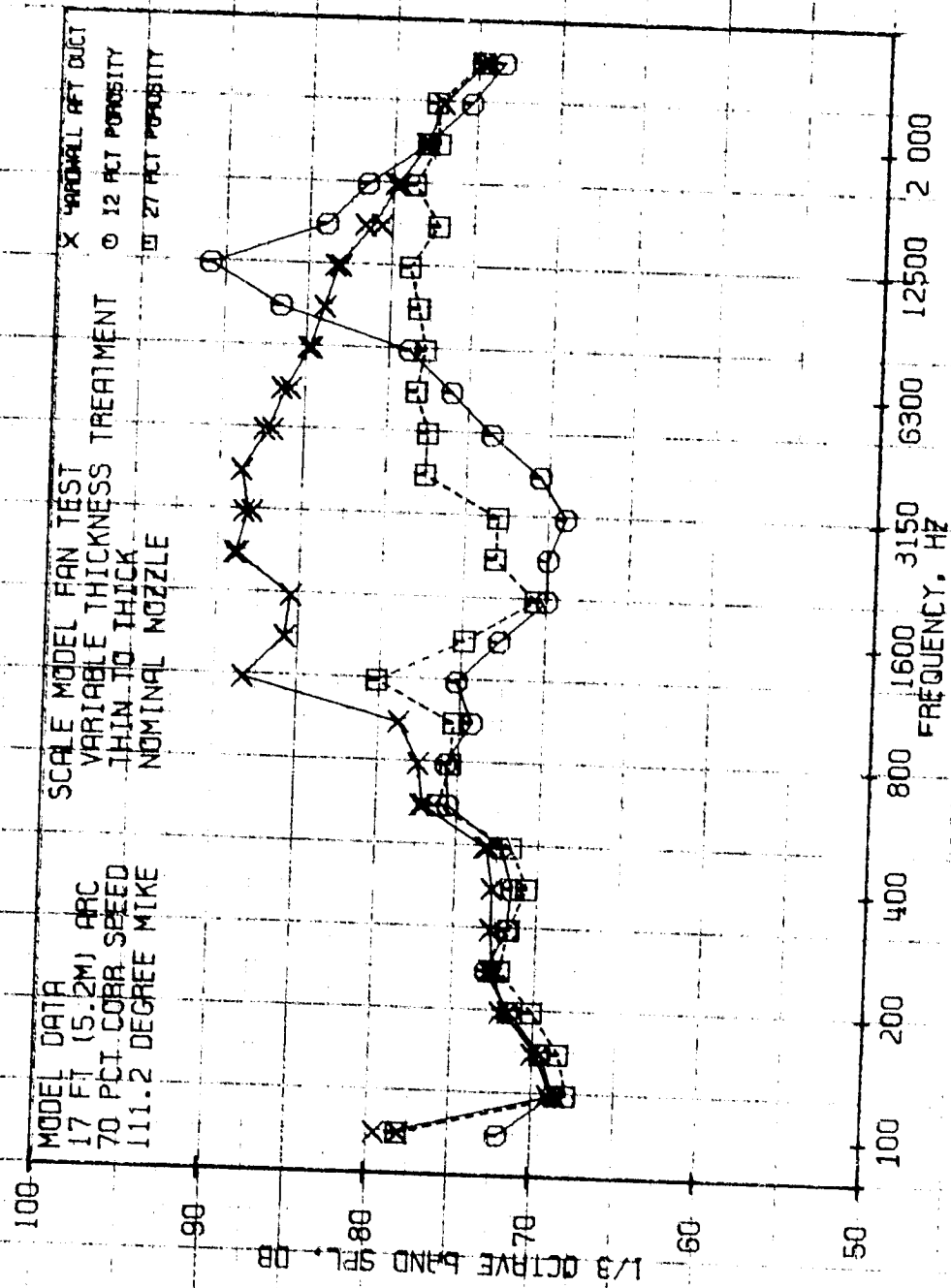


FIGURE 66

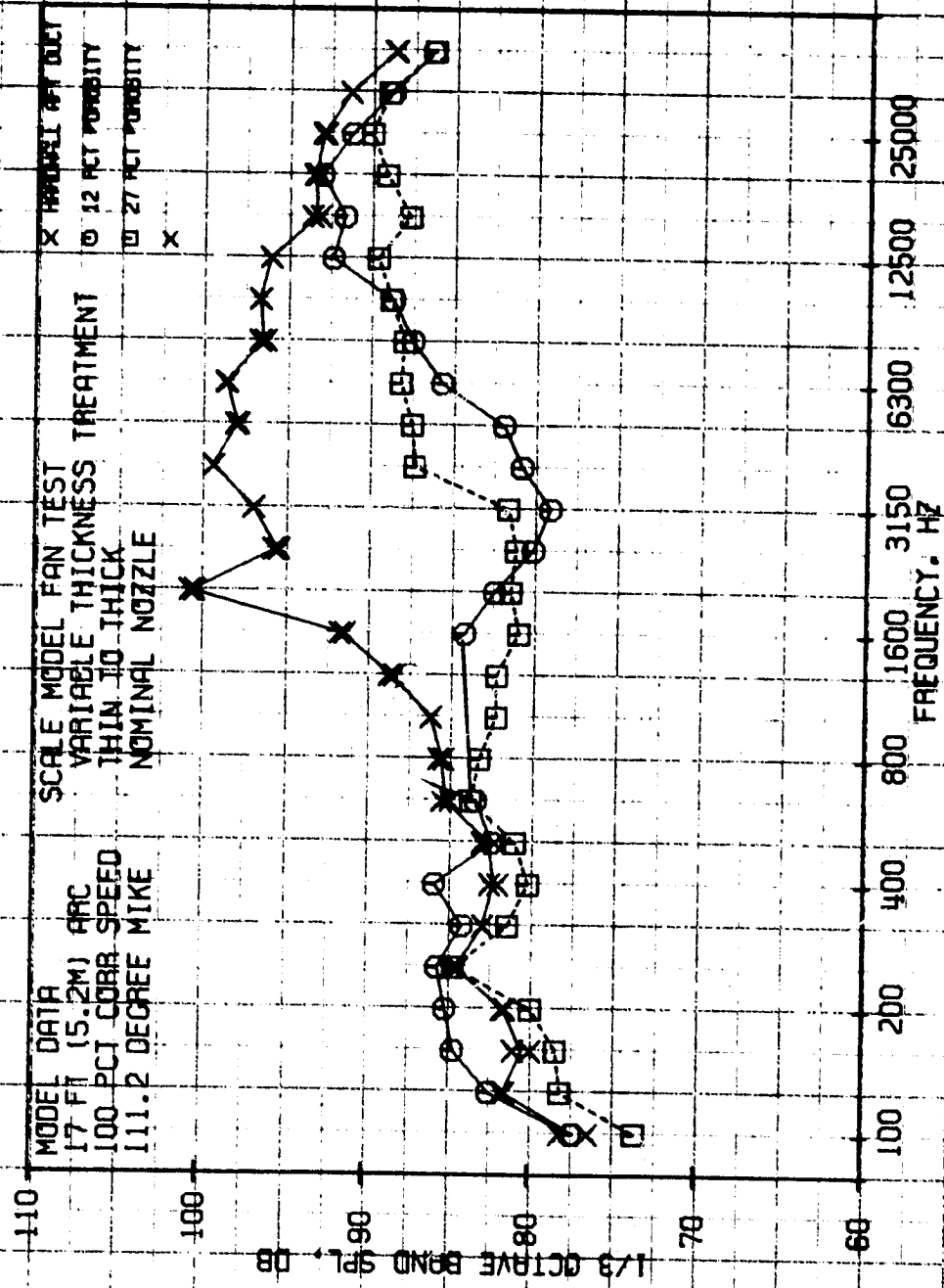


FIGURE 67

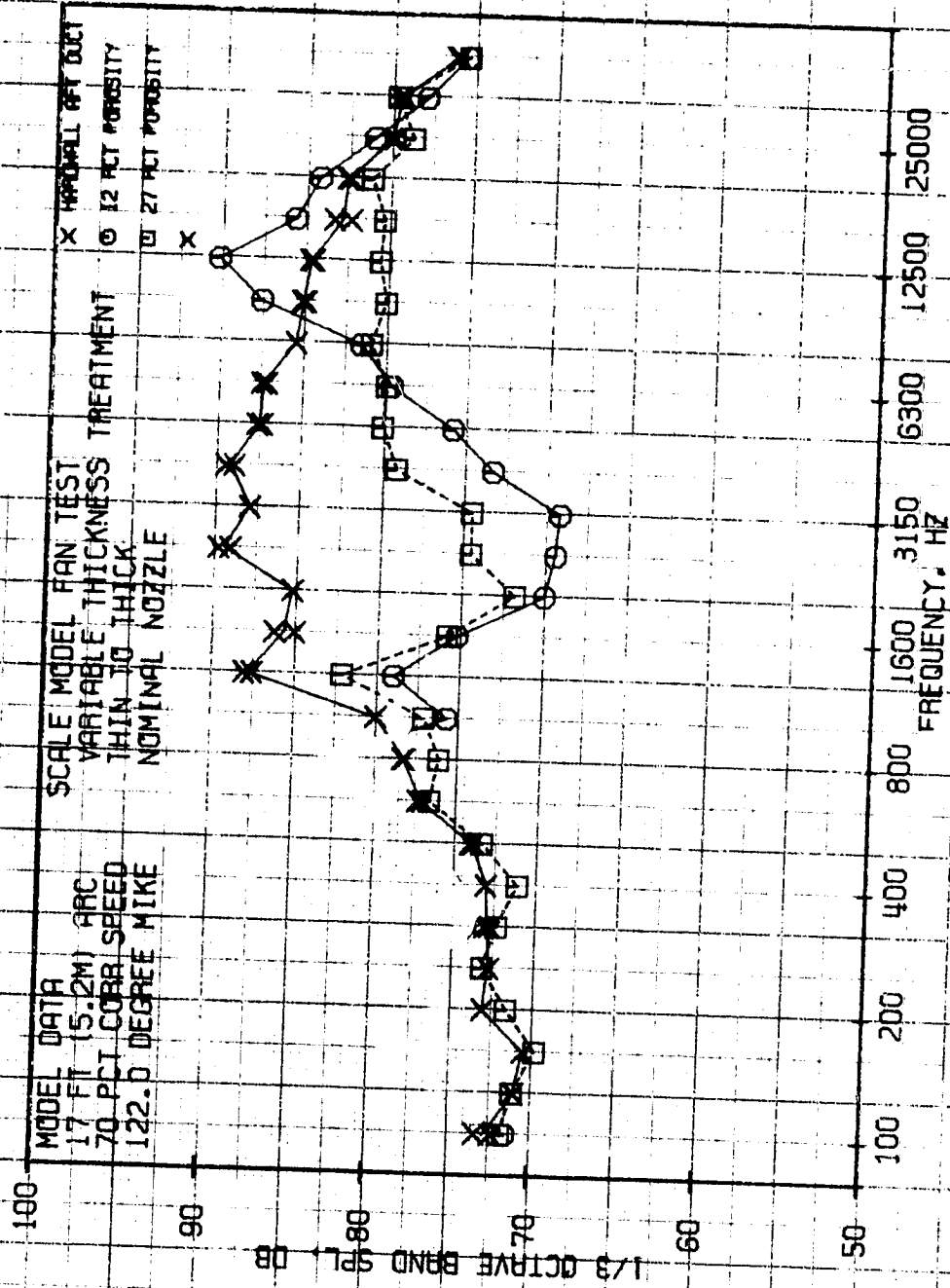


FIGURE 68

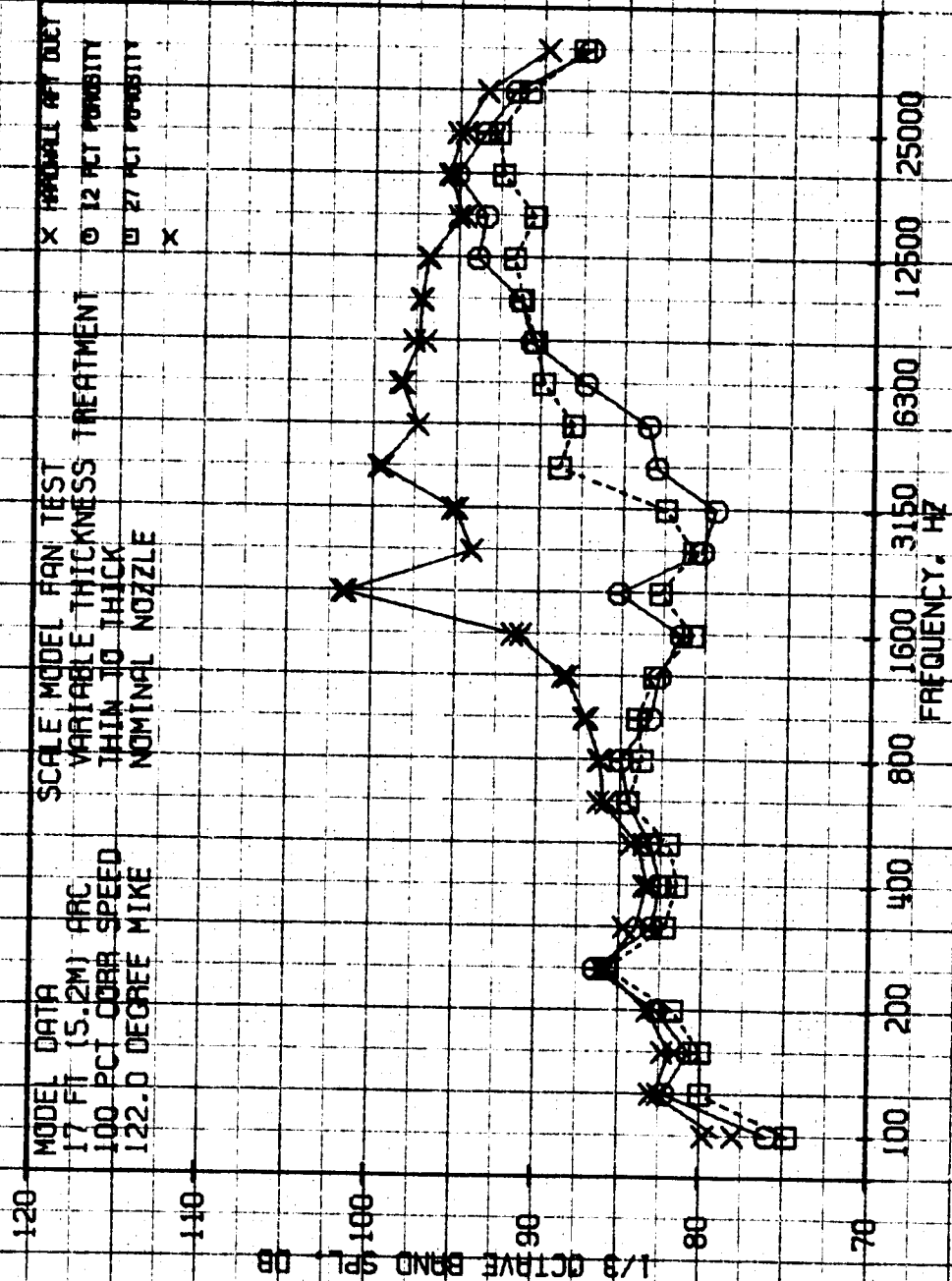
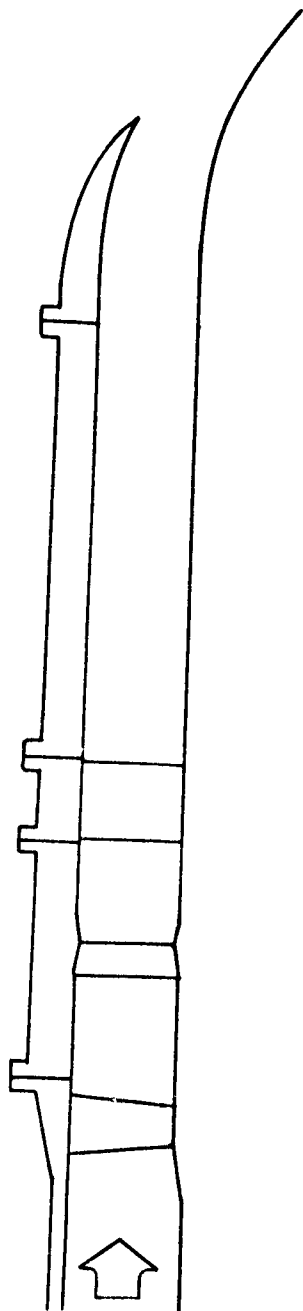


FIGURE 69

CONFIGURATION 18, HARDWALL



CONFIGURATION 7, POROSITY = 12%

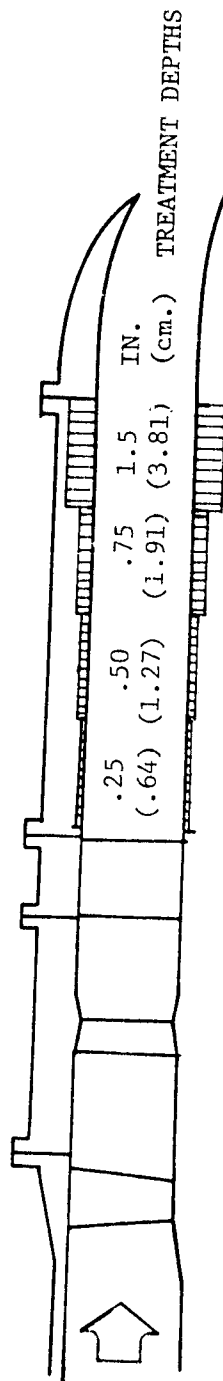


FIGURE 70. 12 PERCENT POROSITY, VARIABLE DEPTH, THIN-TO-THICK CONFIGURATION

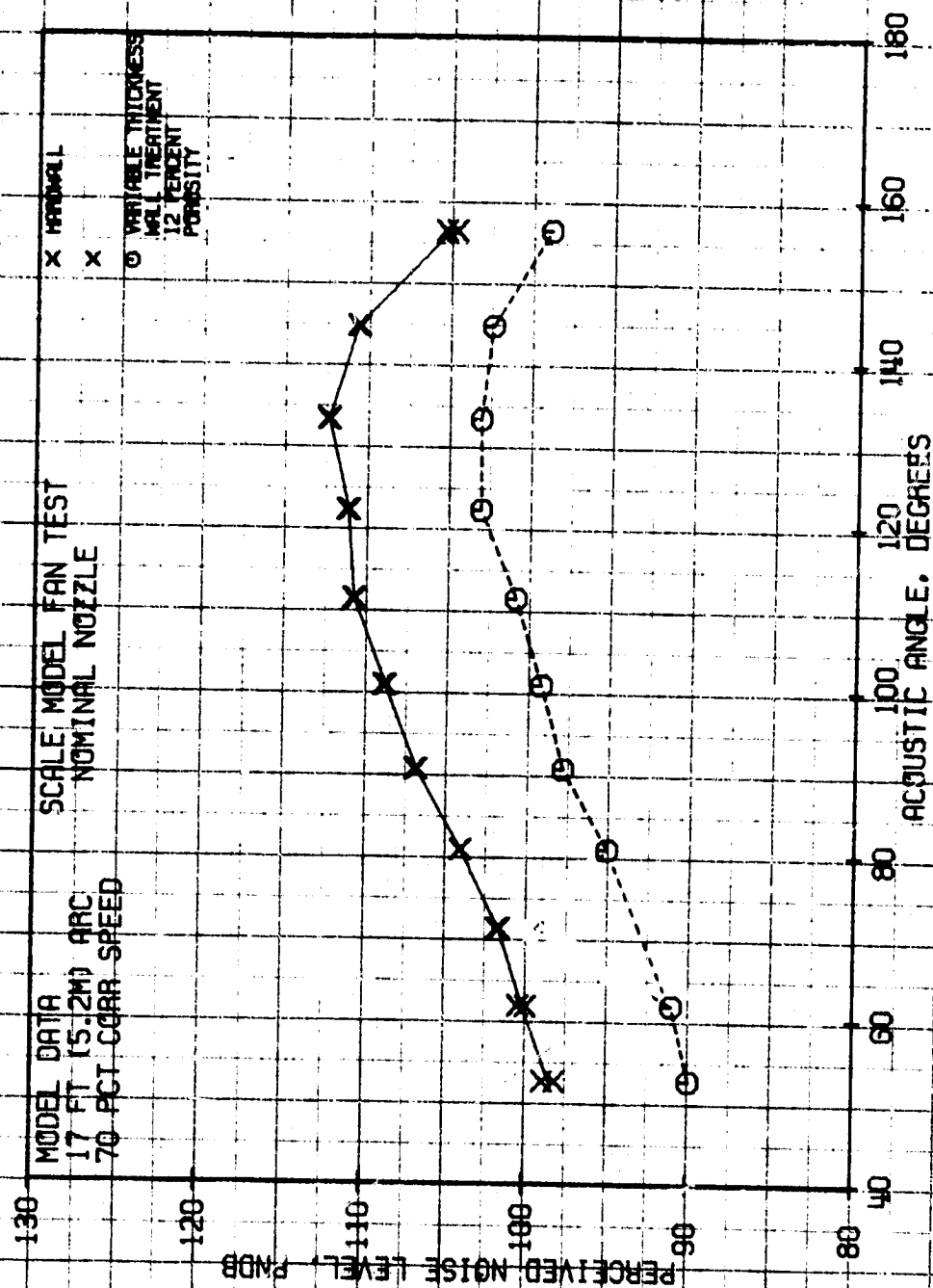


FIGURE 71

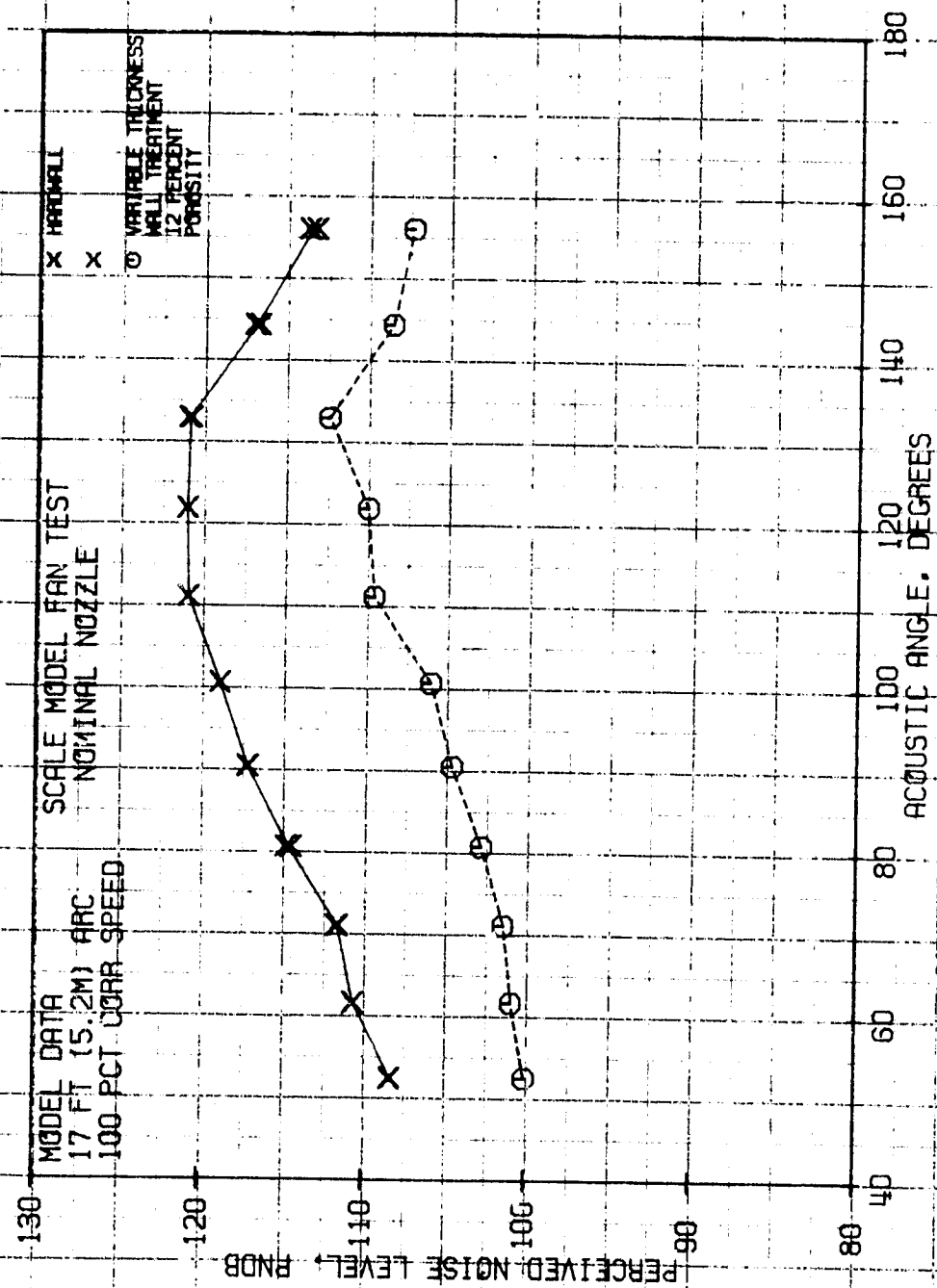


FIGURE 72

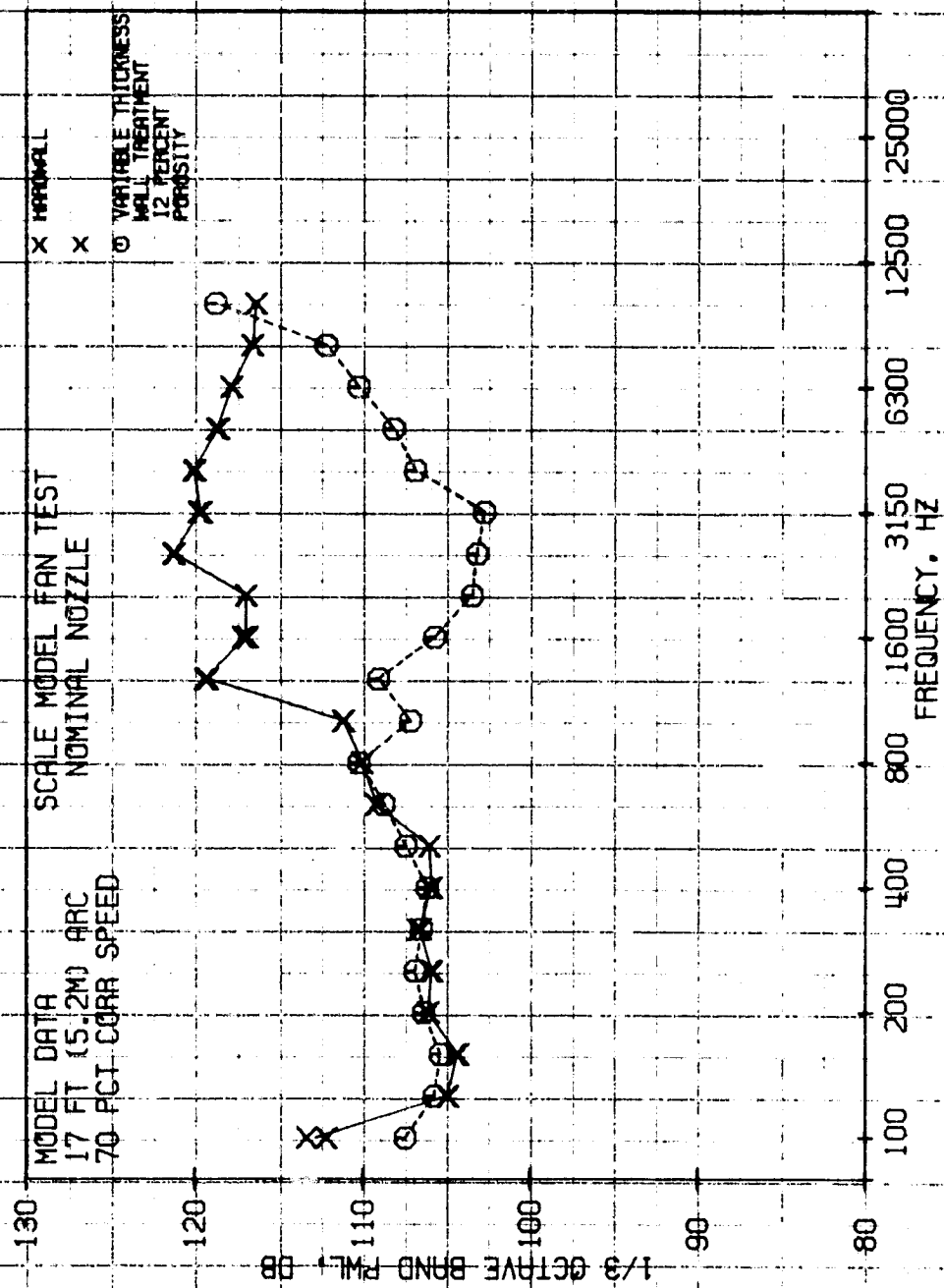


FIGURE 73



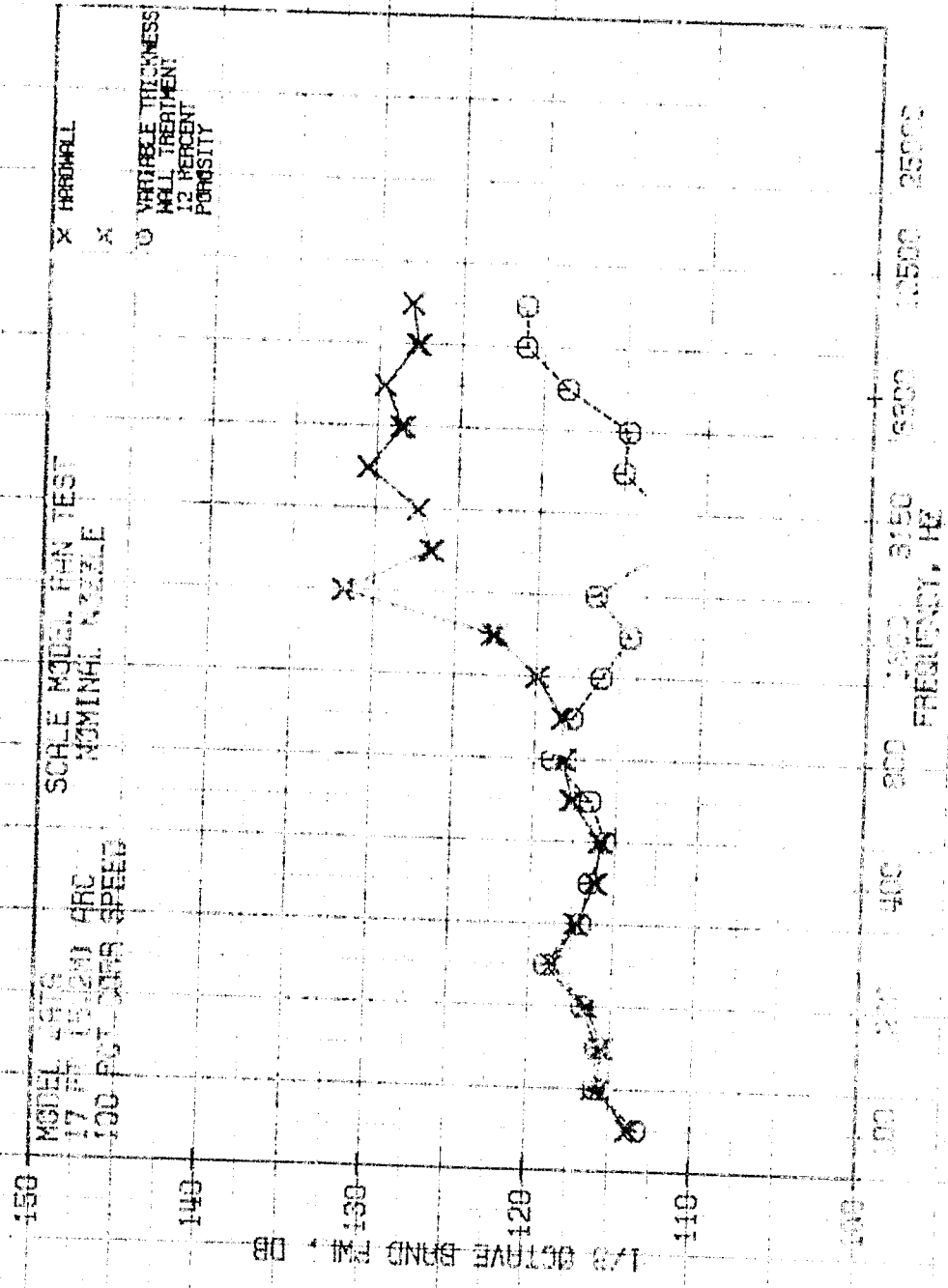


FIGURE 14

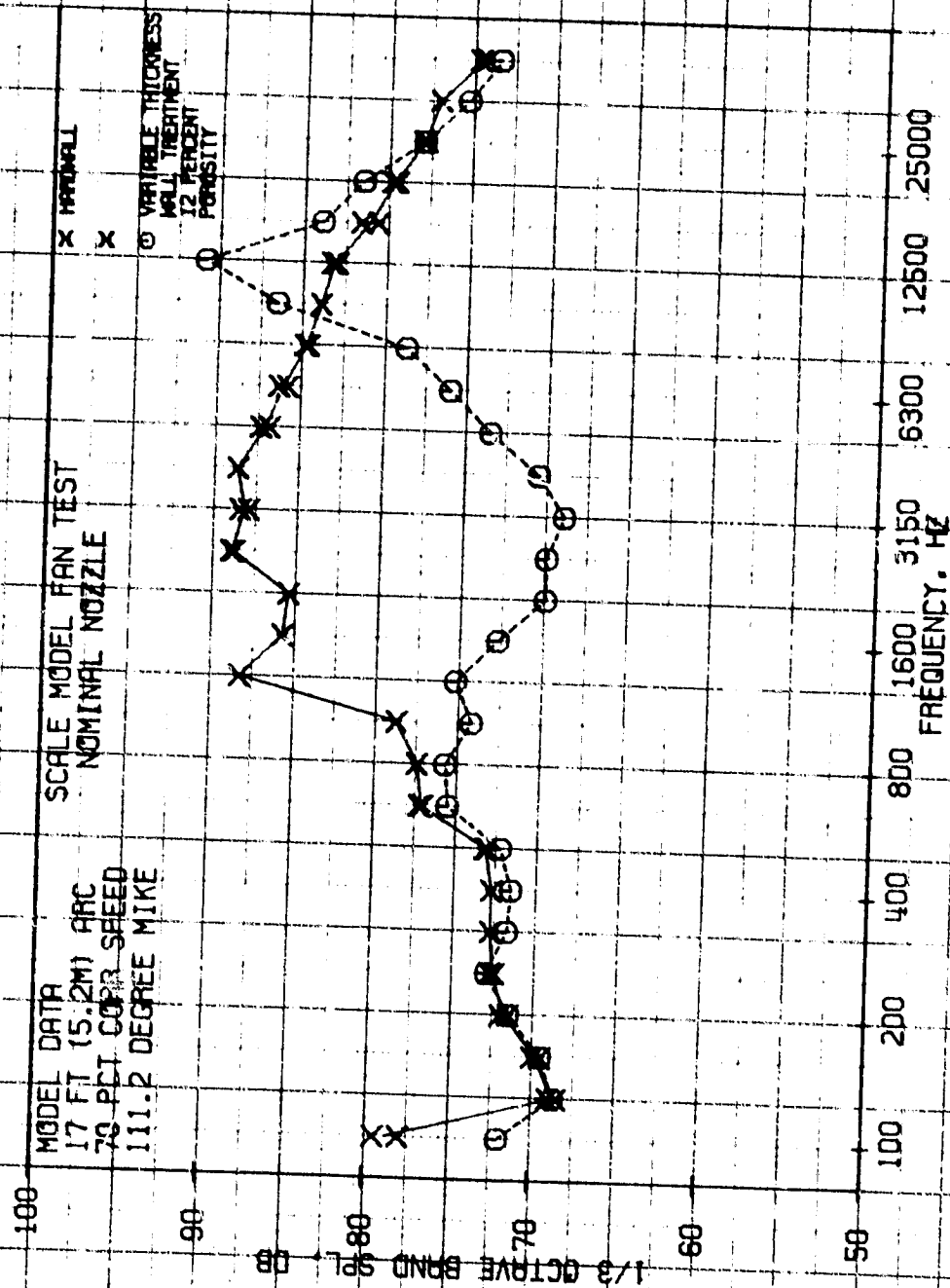


FIGURE 75

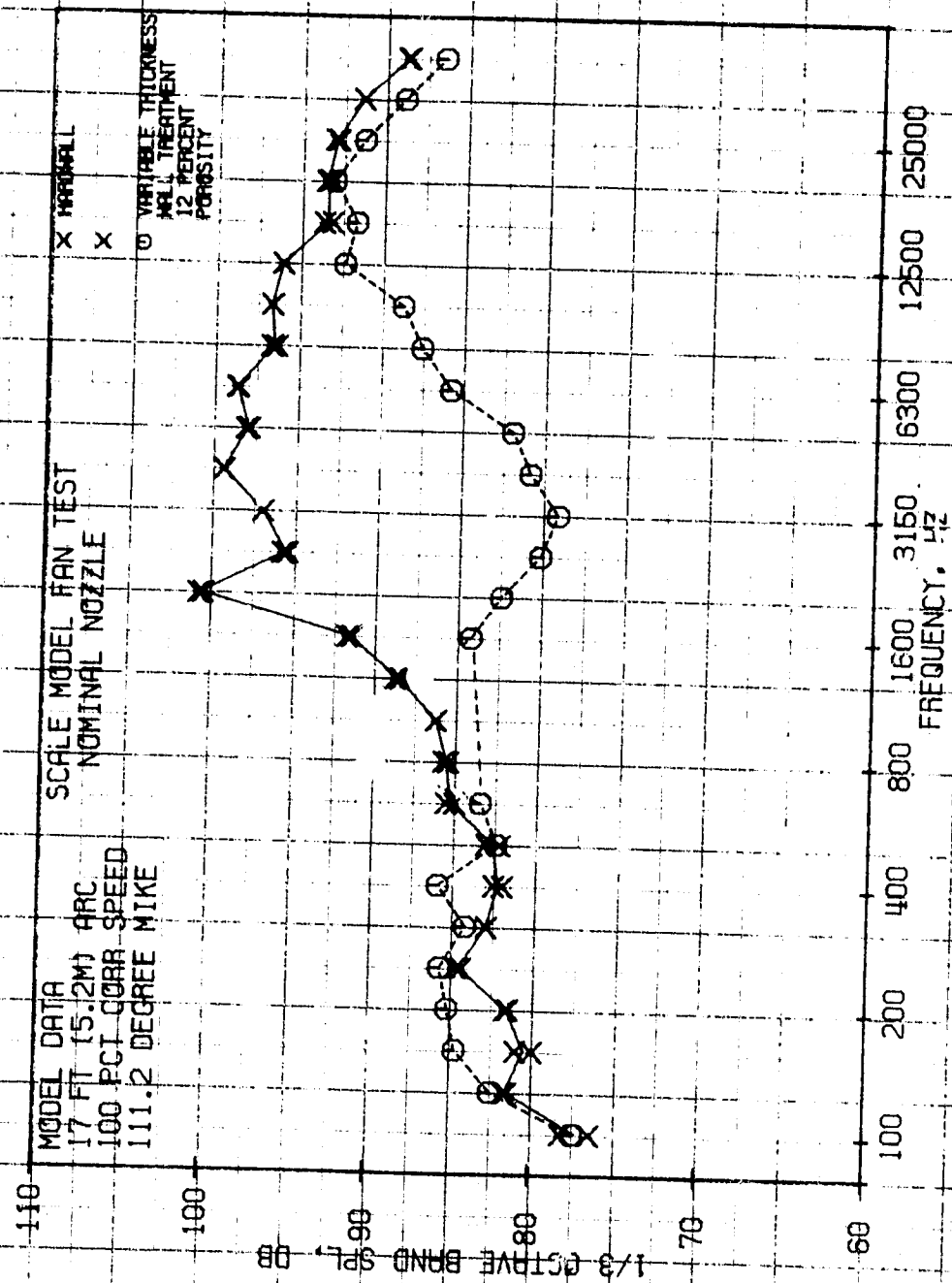


FIGURE 76

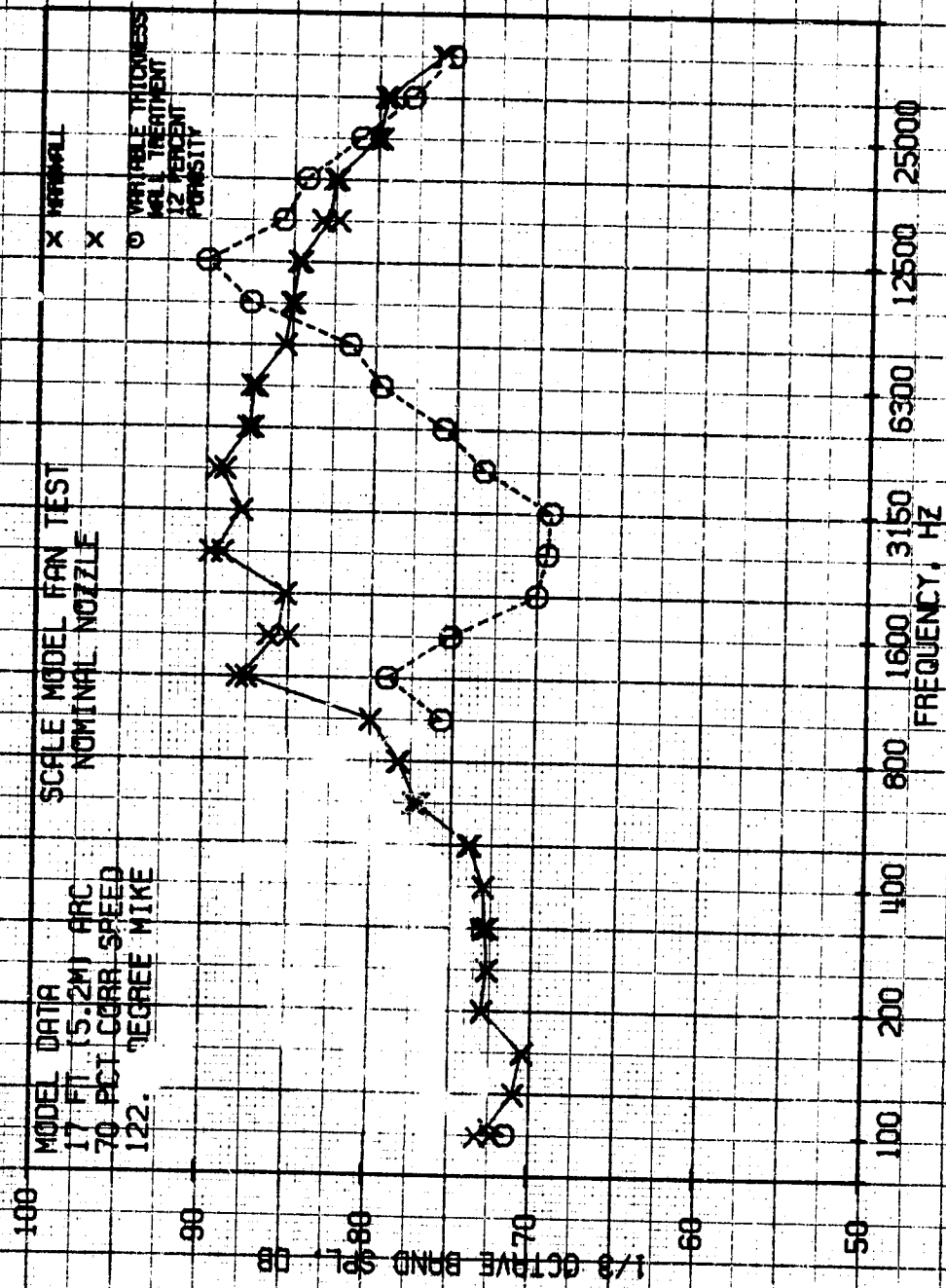


FIGURE 77

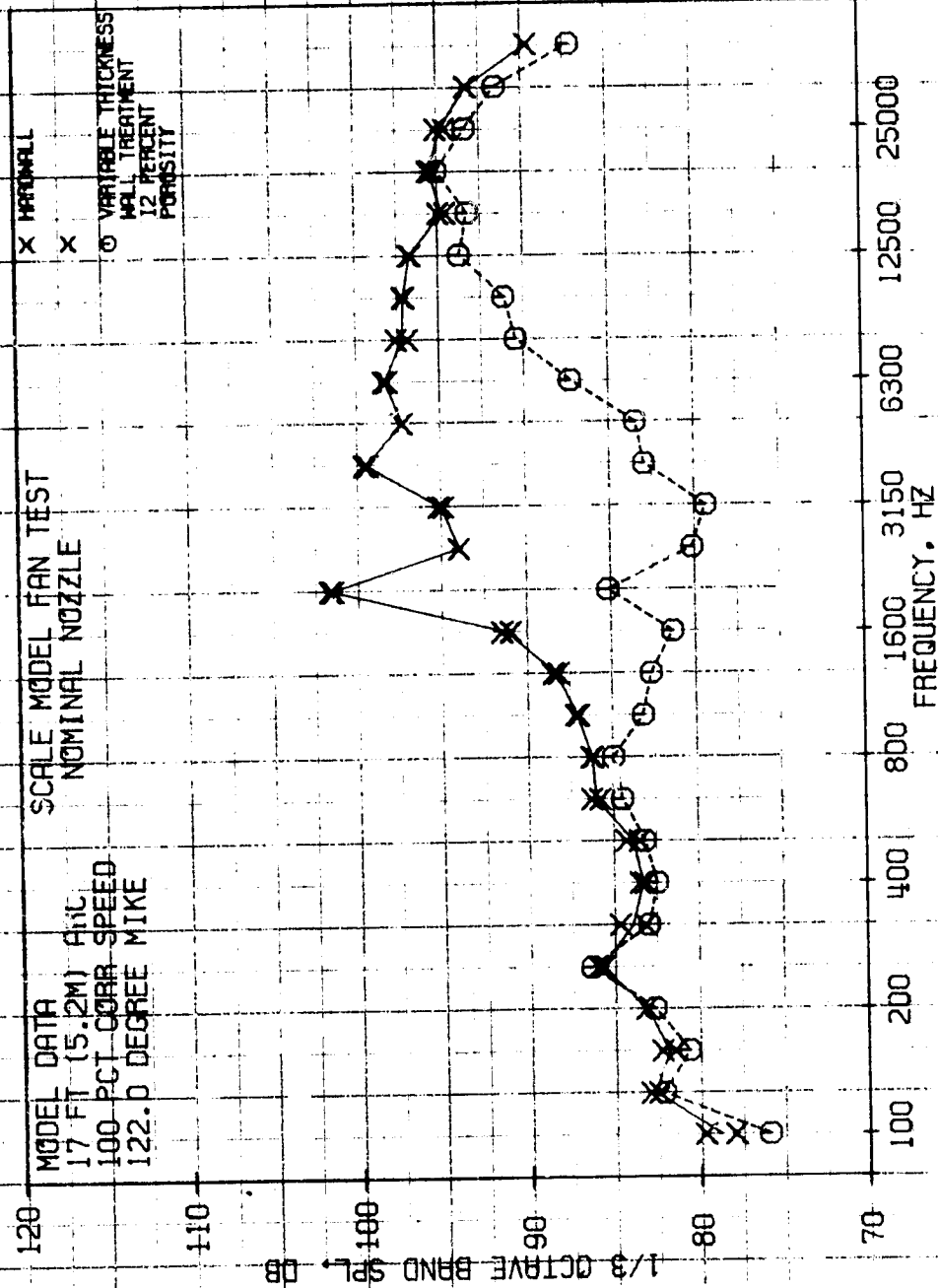
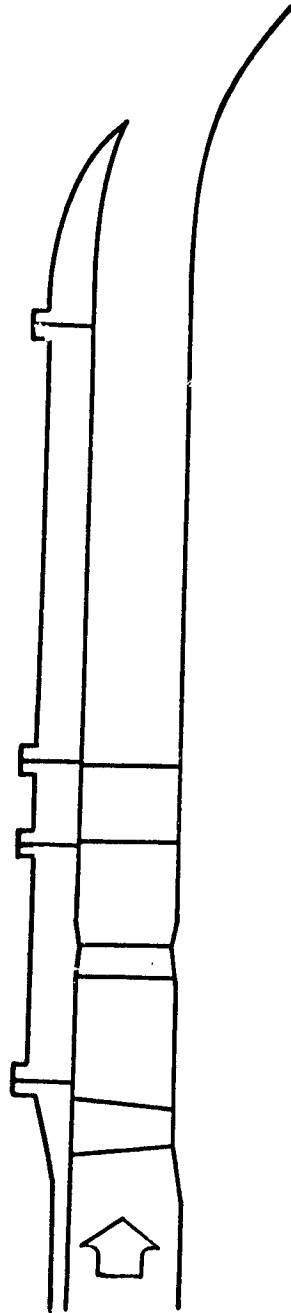
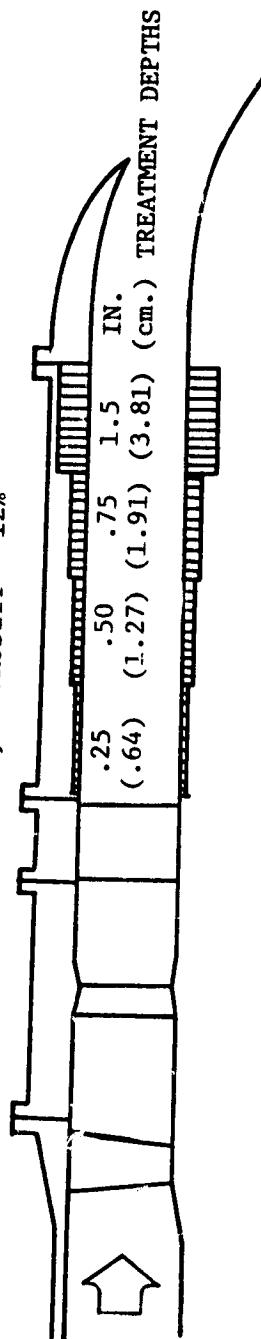


FIGURE 78

CONFIGURATION 18, HARDWALL



CONFIGURATION 7, POROSITY = 12%



CONFIGURATION 26, POROSITY = 12%

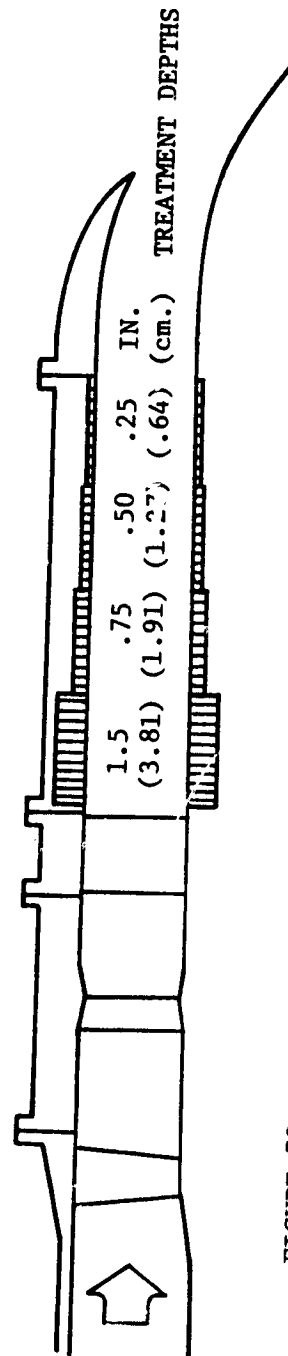


FIGURE 79. 12 PERCENT POROSITY THIN-TO-THICK VS THICK-TO-THIN CONFIGURATIONS

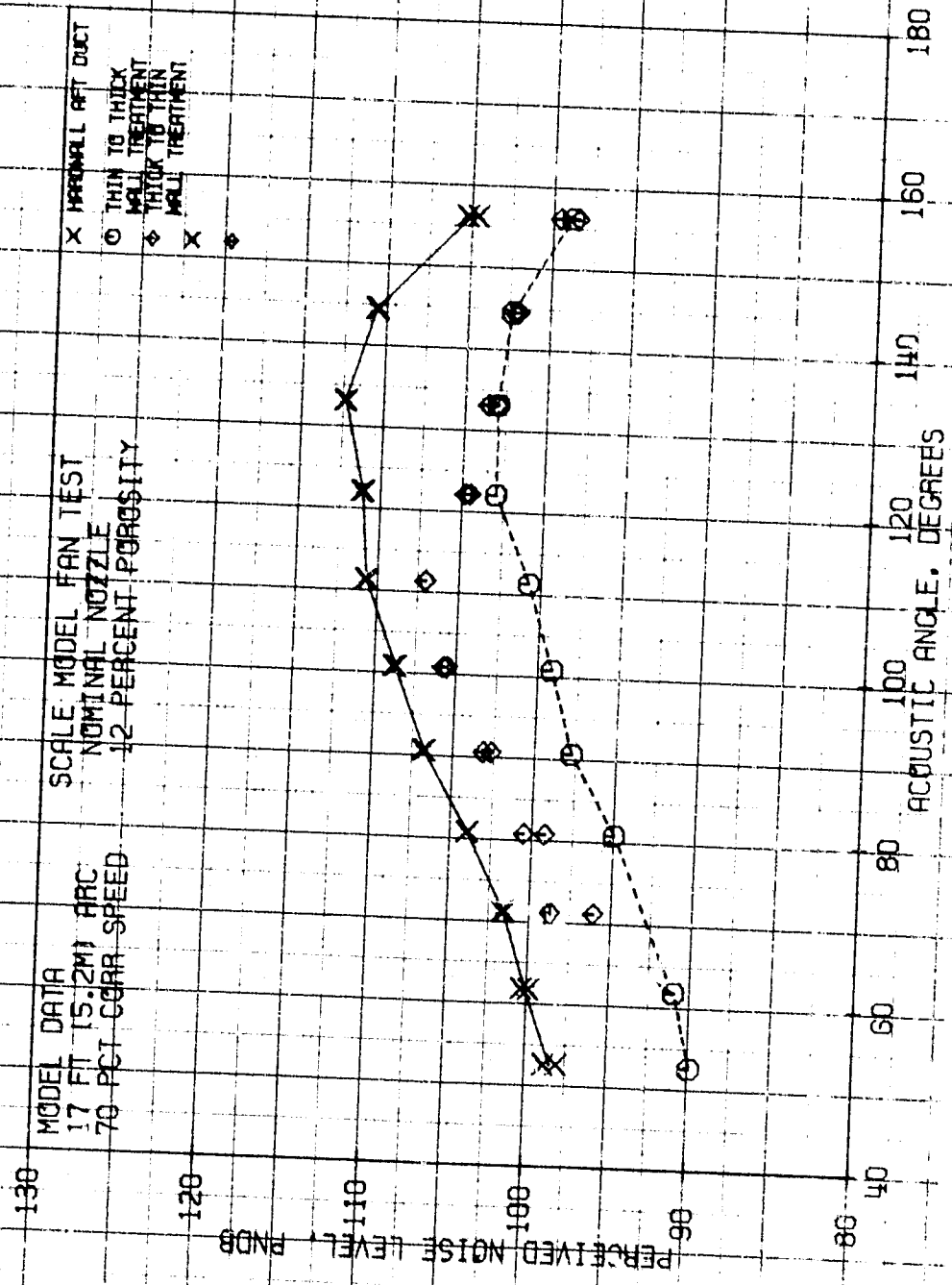


FIGURE 80

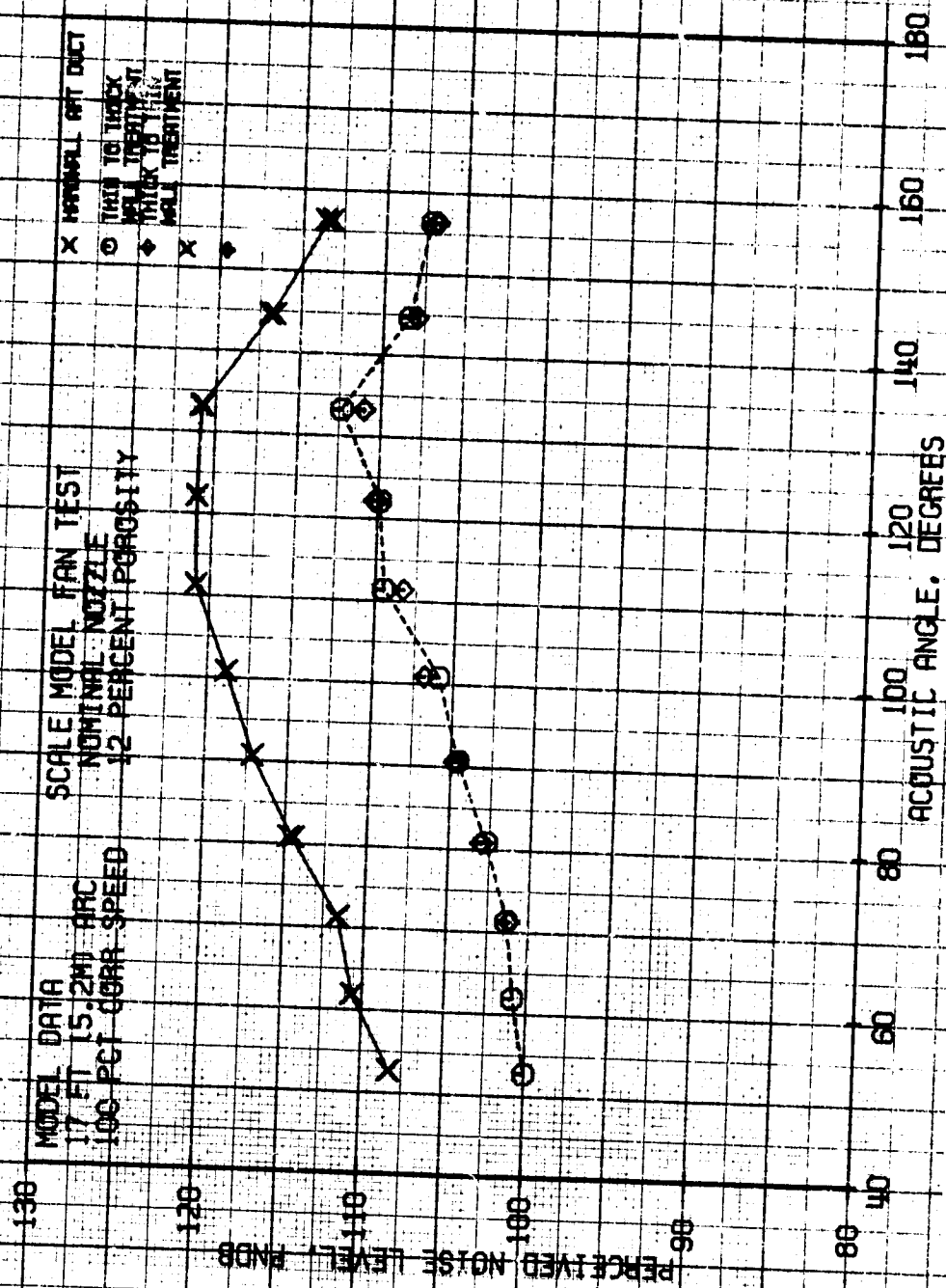


FIGURE 81



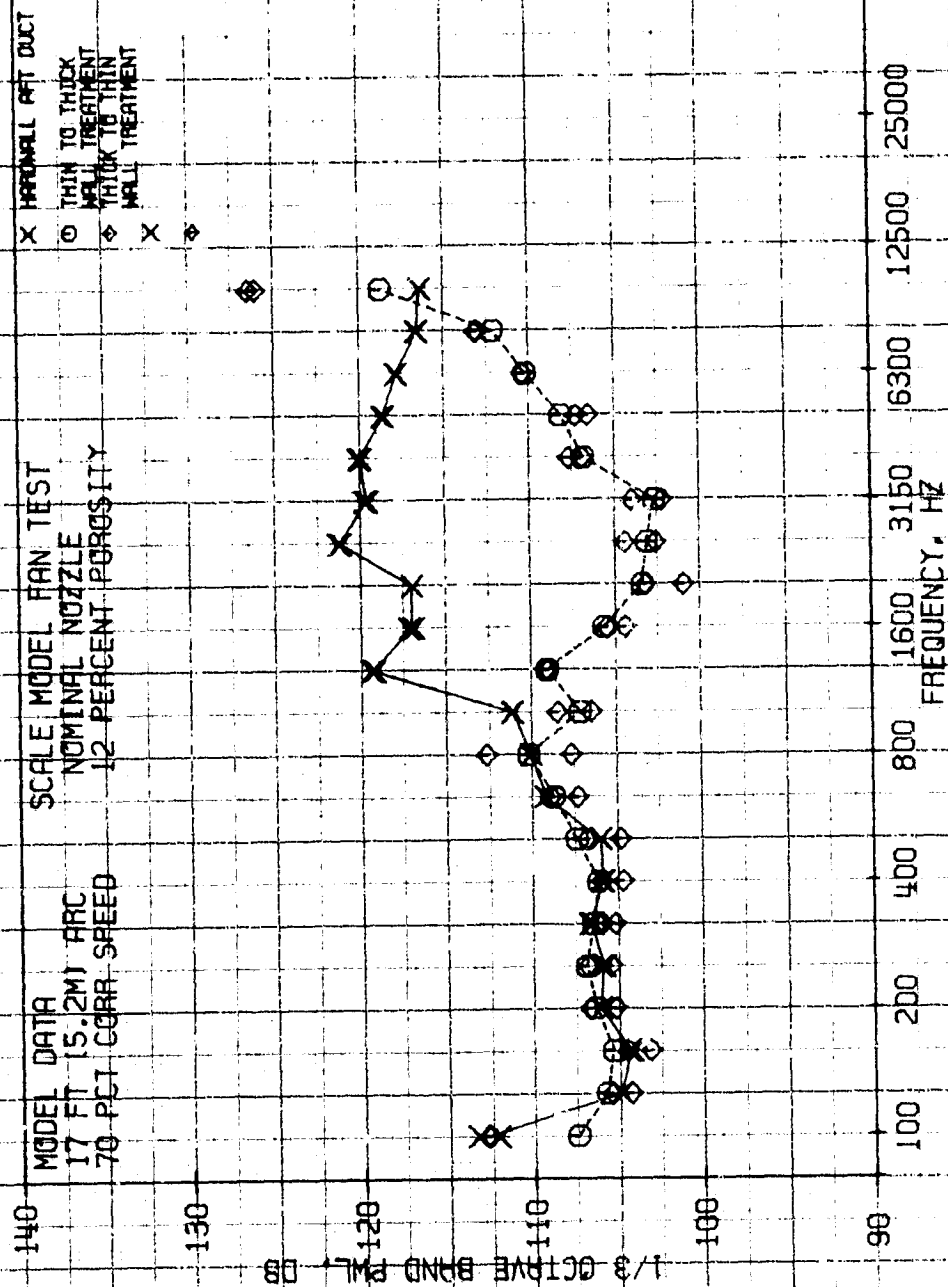


FIGURE 82

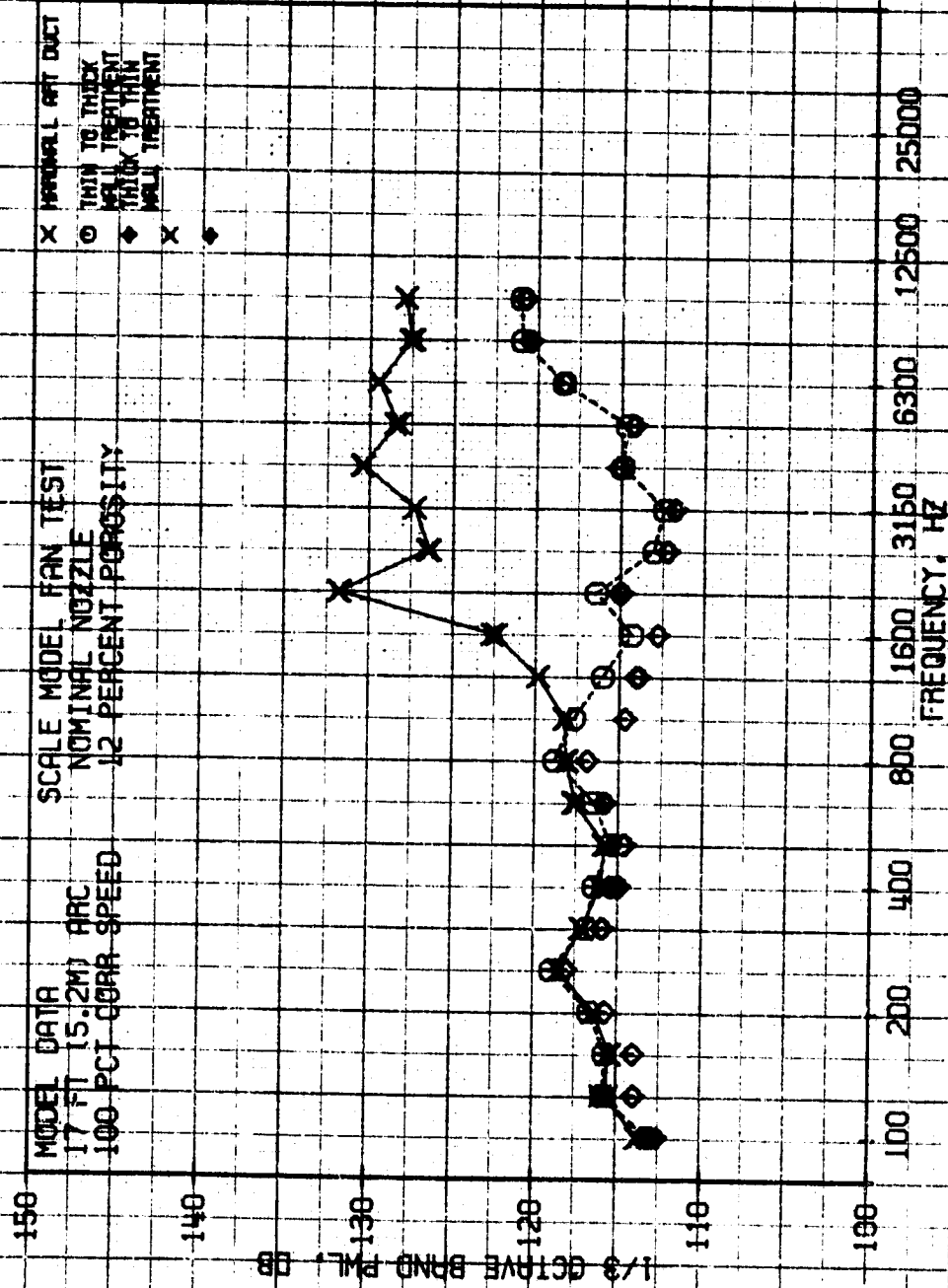


FIGURE 83

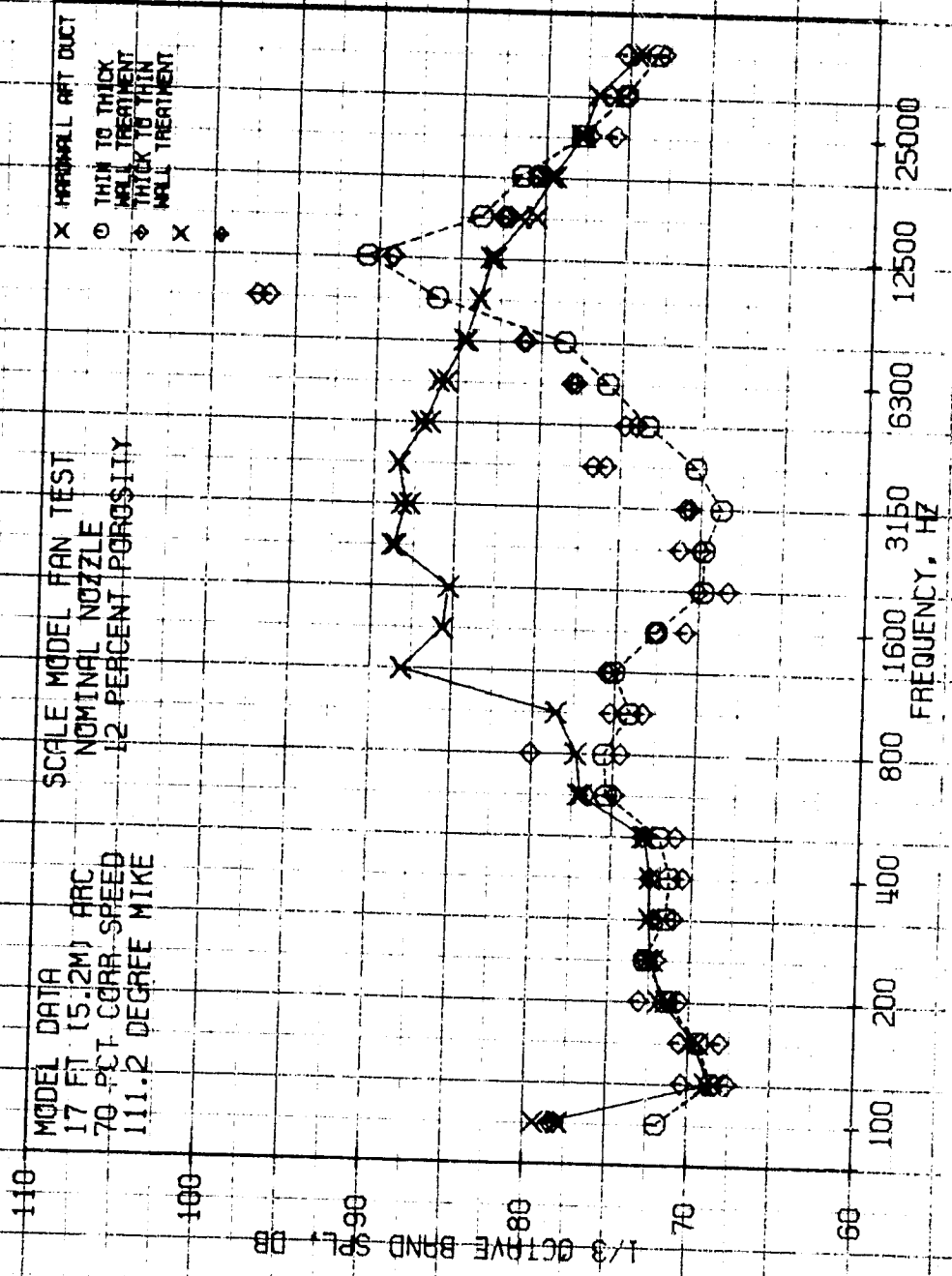


FIGURE 84

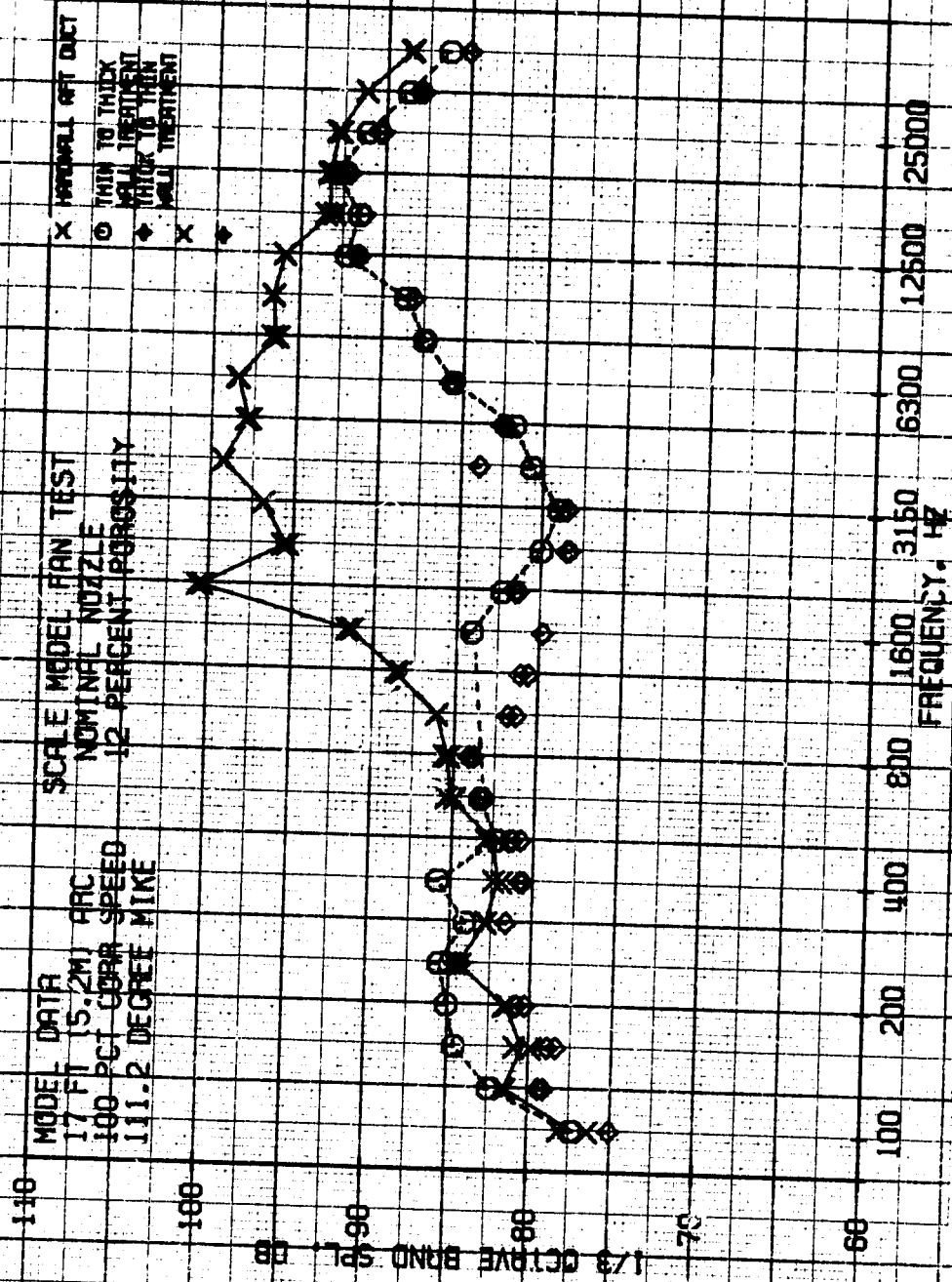


FIGURE 85

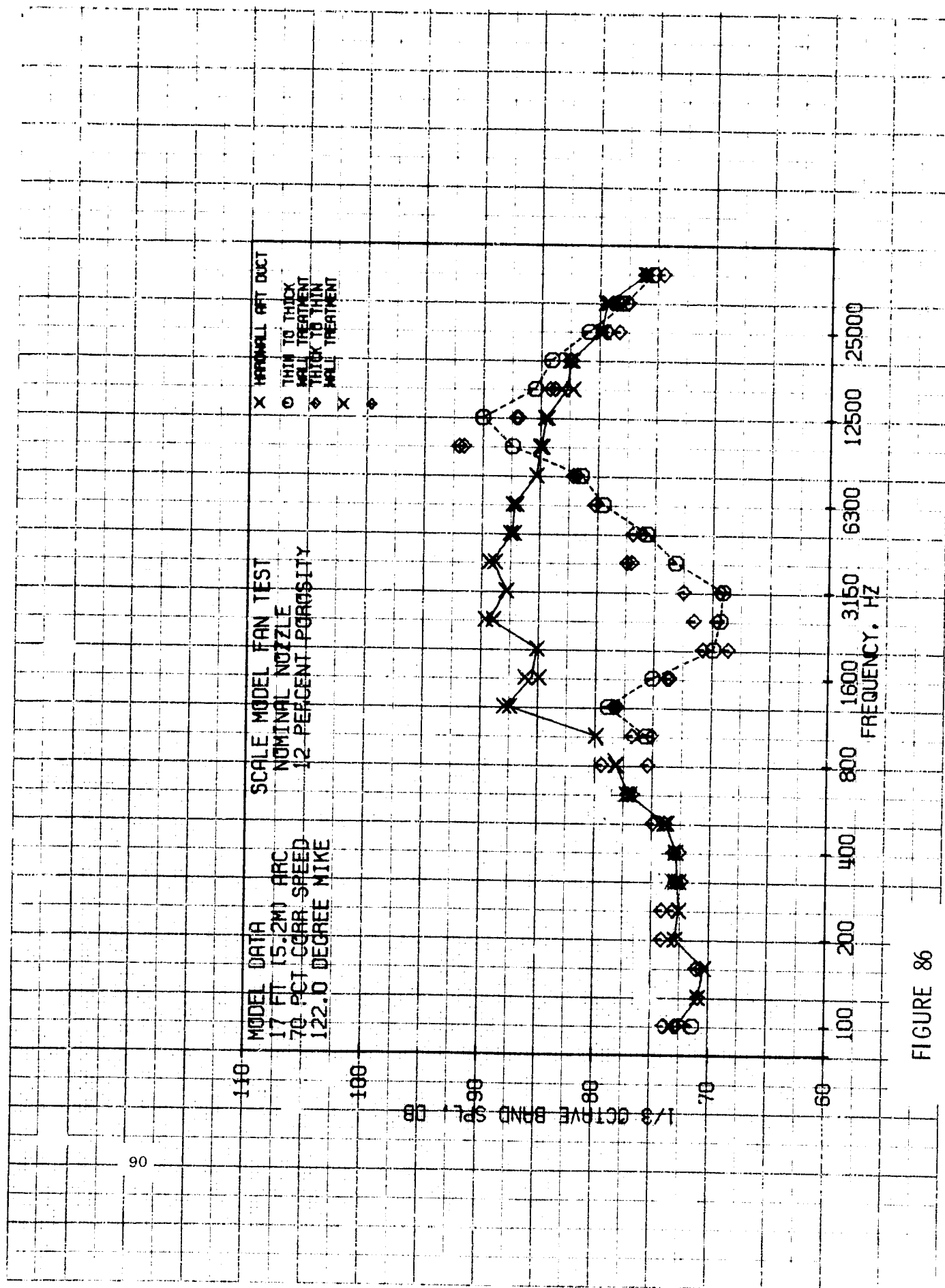


FIGURE 86

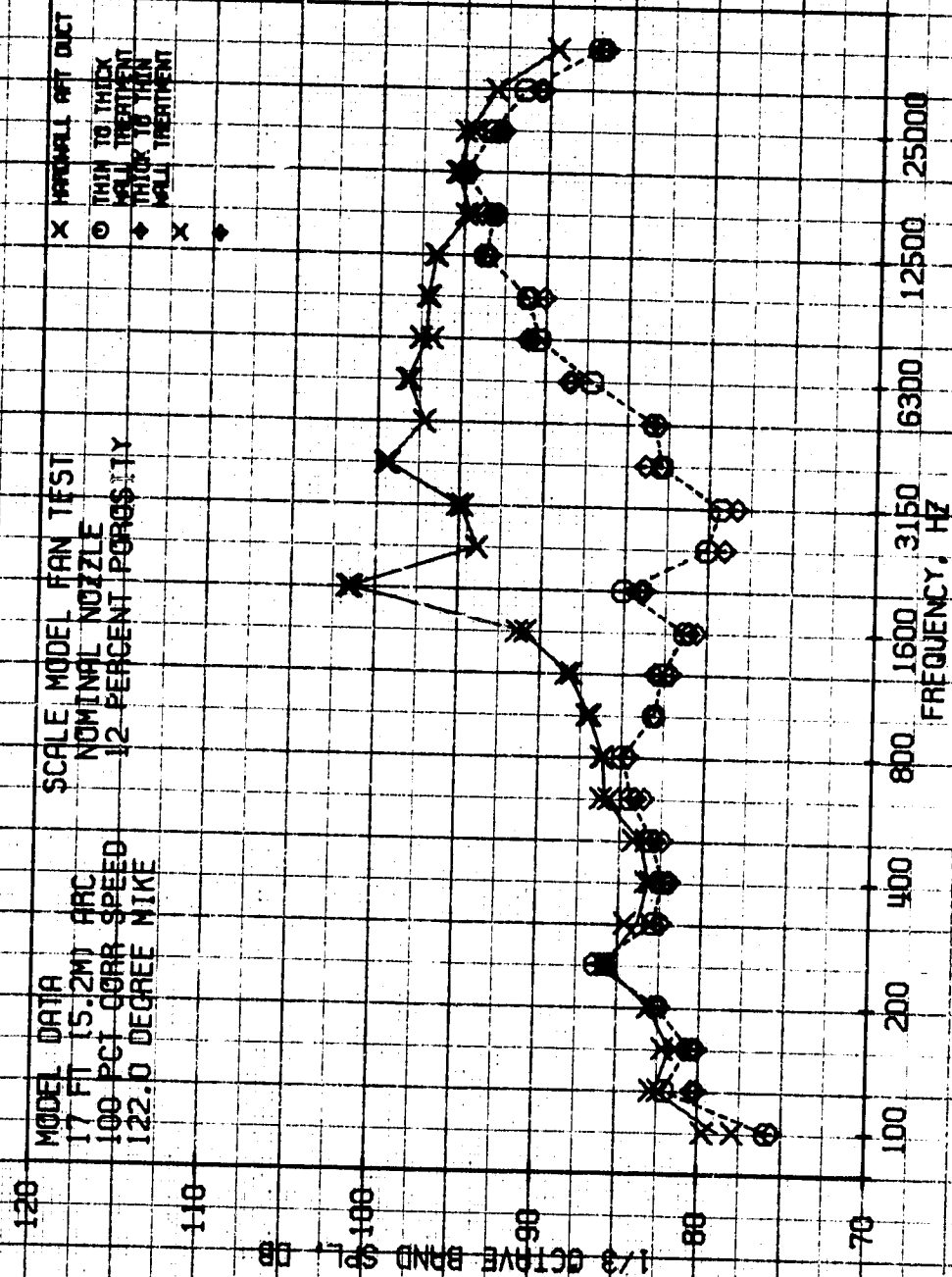
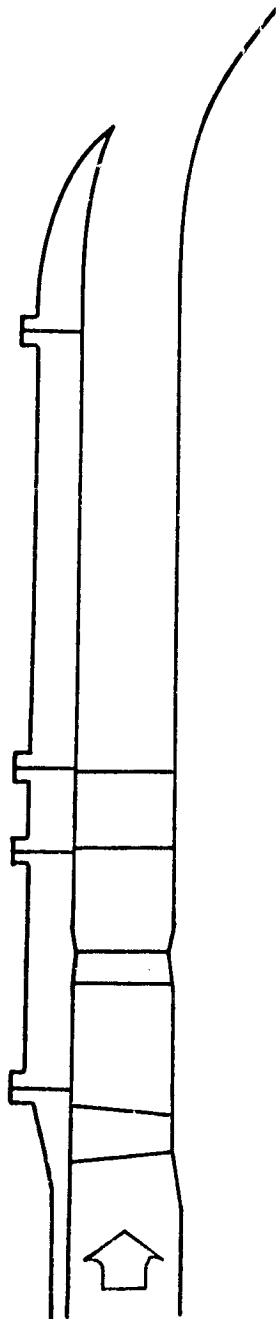
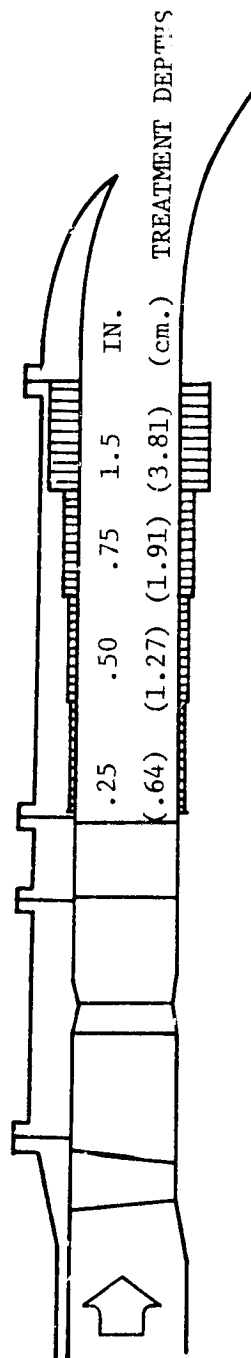


FIGURE 87

CONFIGURATION 18, HARDWALL



CONFIGURATION 7, POROSITY = 12%



CONFIGURATION 75-2, POROSITY = 12%, SLANT CELL ROTOR-OGV TREATMENT

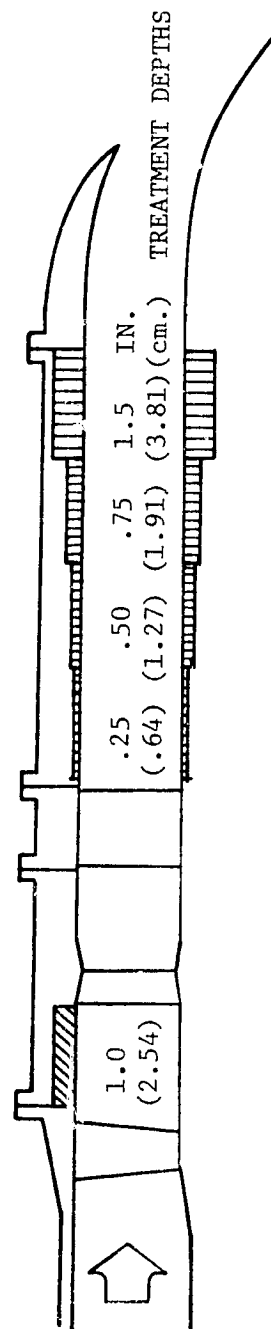


FIGURE 88. ROTOR-OGV TREATMENT AND VARIABLE DEPTH CONFIGURATIONS

C-2

MODEL DATA  
 17 FT (5.2M) ARC  
 70 PCT CERA SPEED  
 SCALE MODEL FAN TEST  
 12 PCT POROSITY FACEPLATE  
 NOMINAL NOZZLE  
 VARIABLE DEPTH TMT L/H=4.6  
 X HORIZONTAL AFT DUCT  
 X DUCT  
 O WITH ROTOR-BOX  
 TREATMENT  
 O WITHOUT ROTOR-BOX  
 TREATMENT

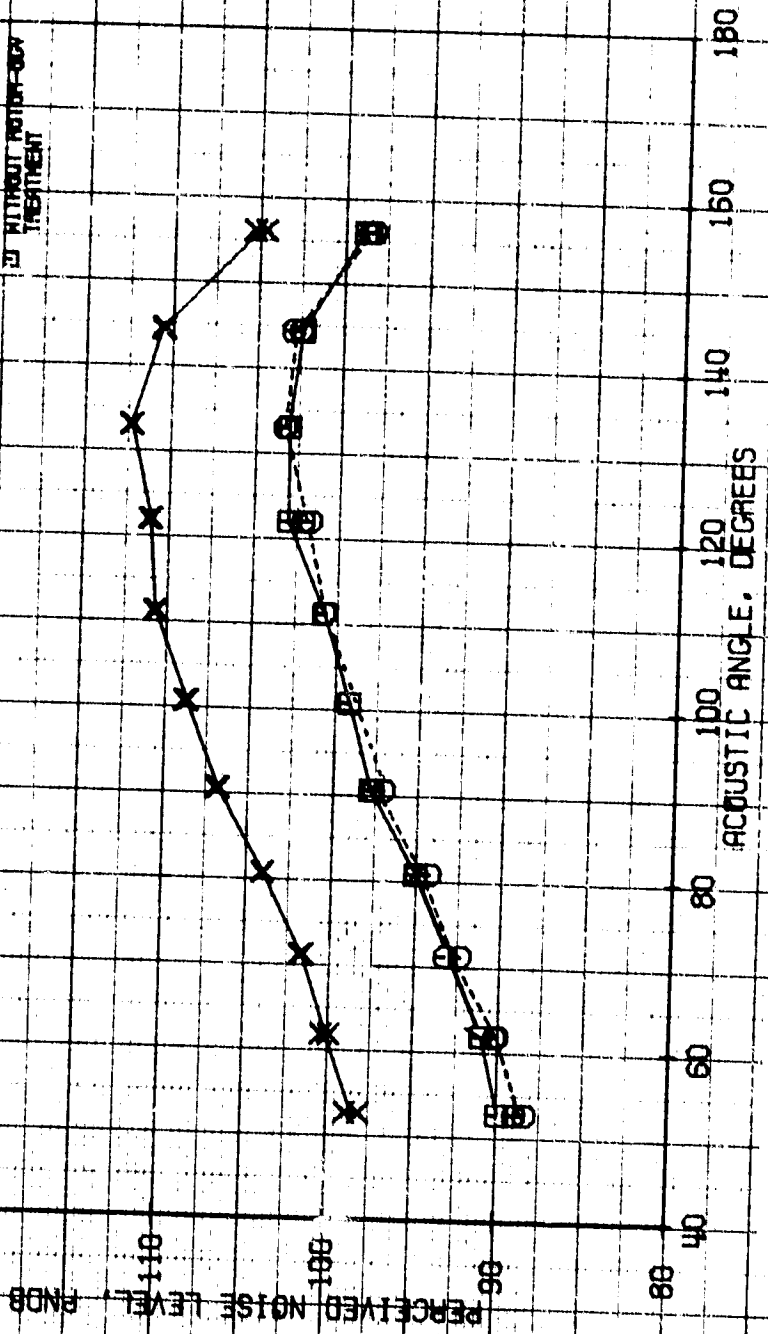


FIGURE 89



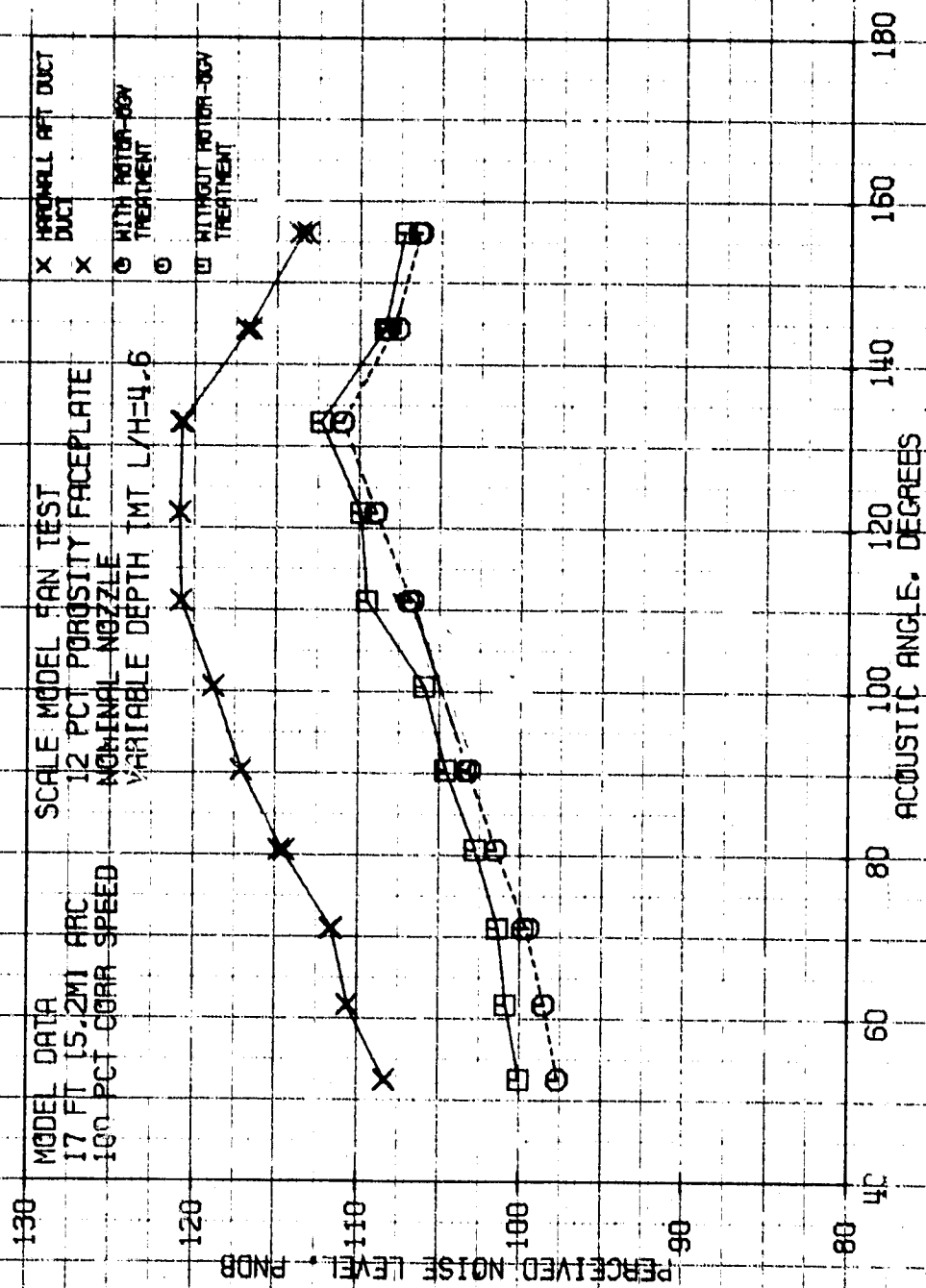


FIGURE 90

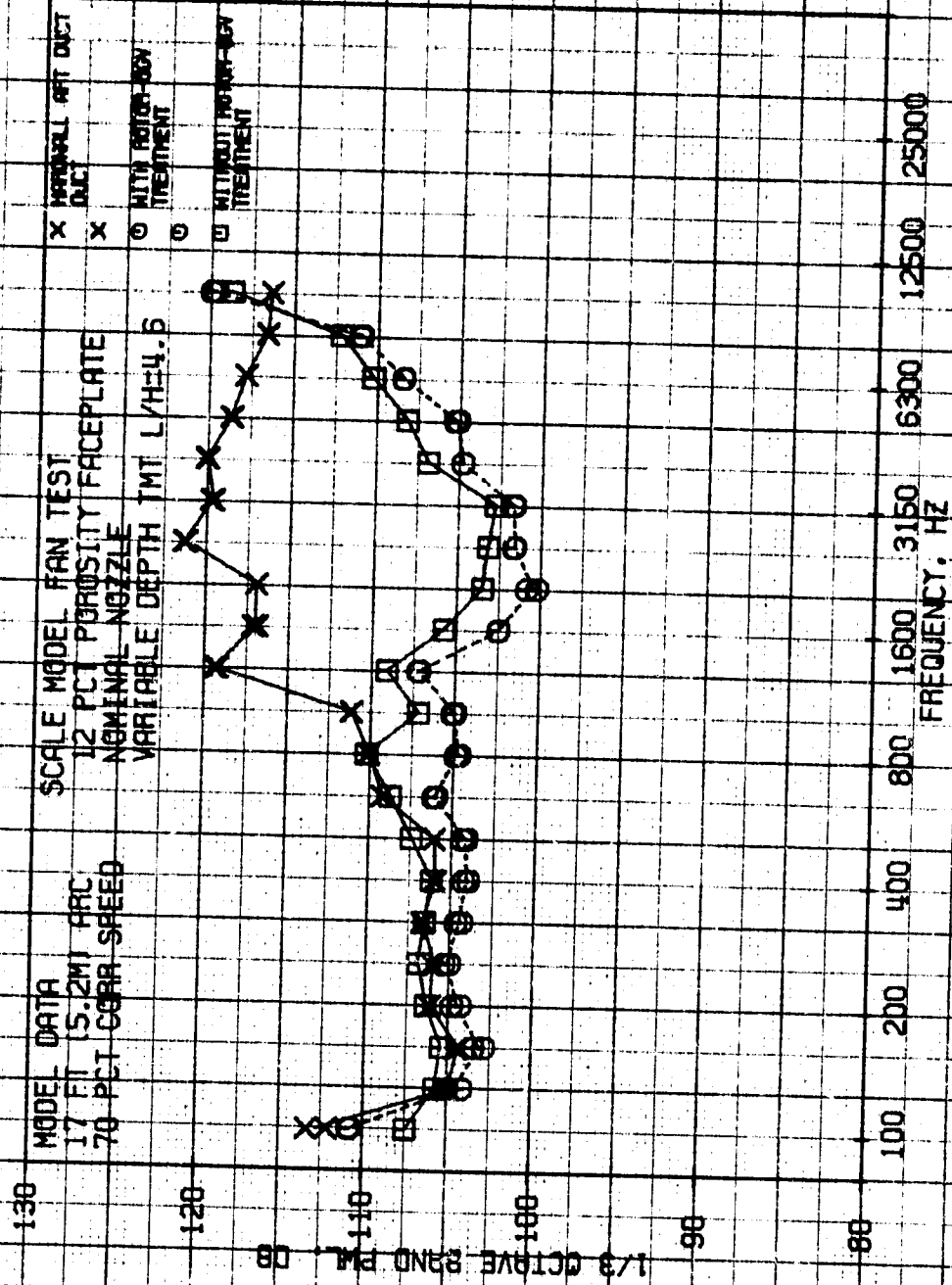


FIGURE 91

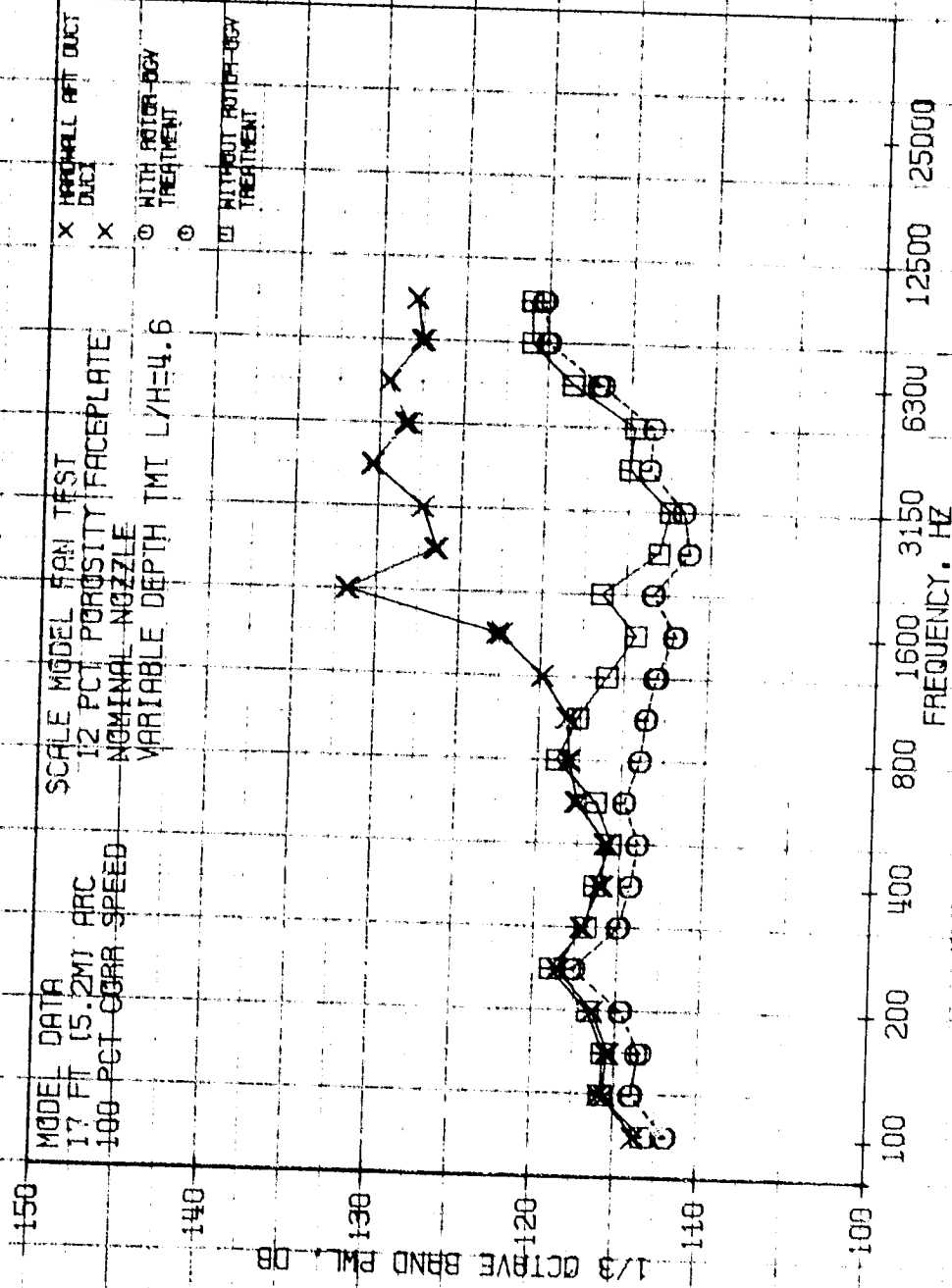


FIGURE 92

ORIGINAL PAGE IS  
OF POOR QUALITY

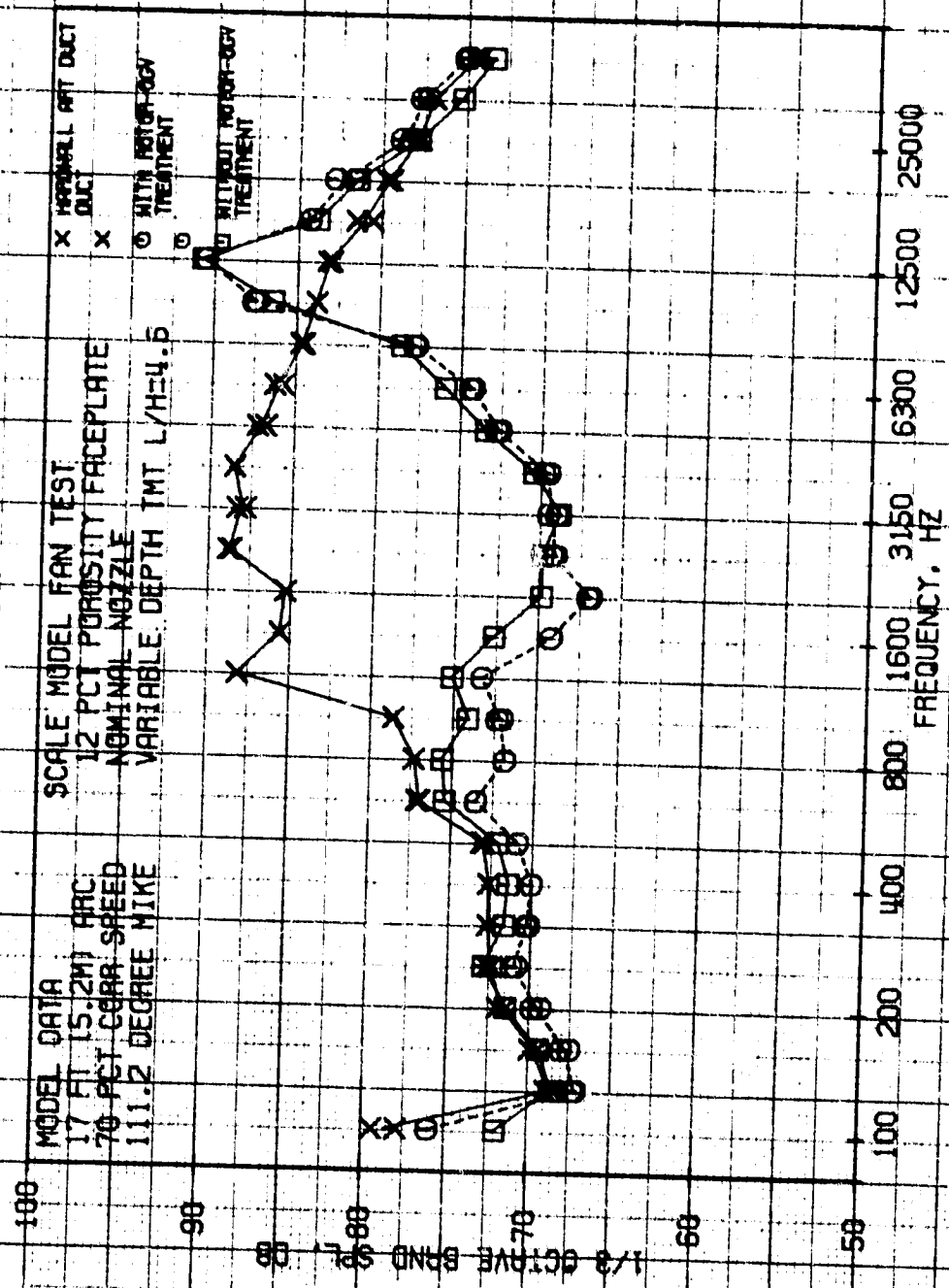


FIGURE 93

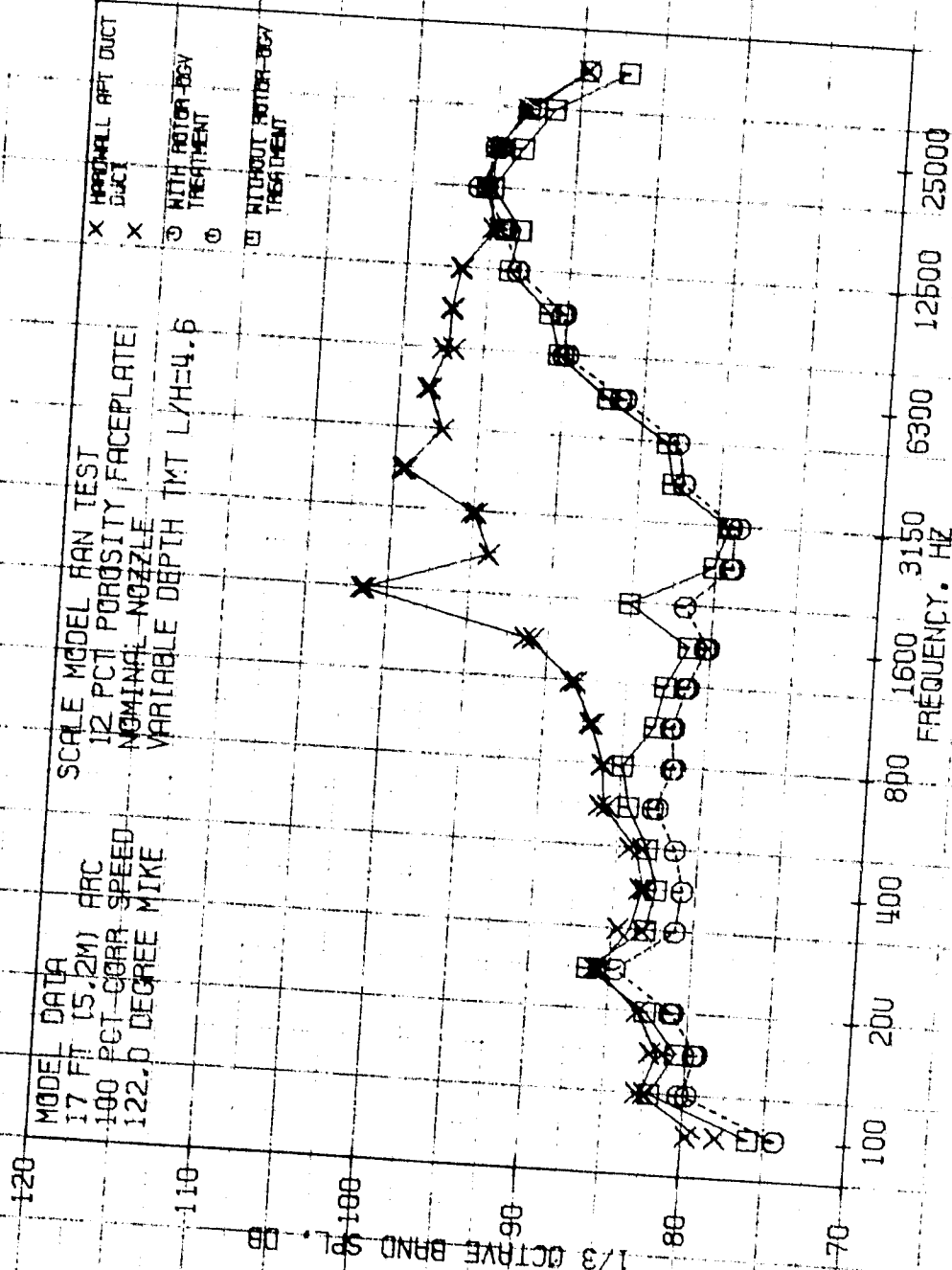


FIGURE 94

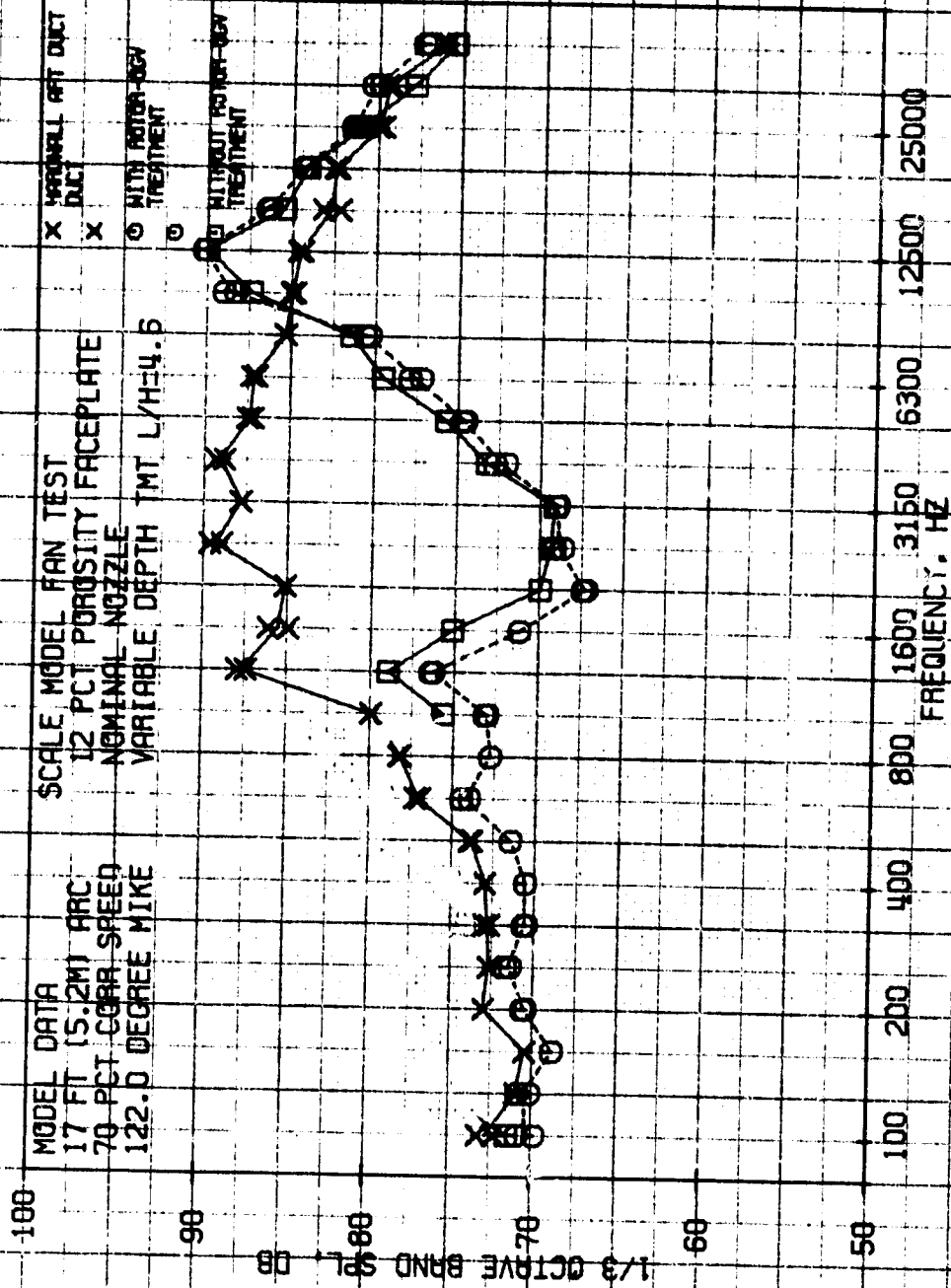


FIGURE 95

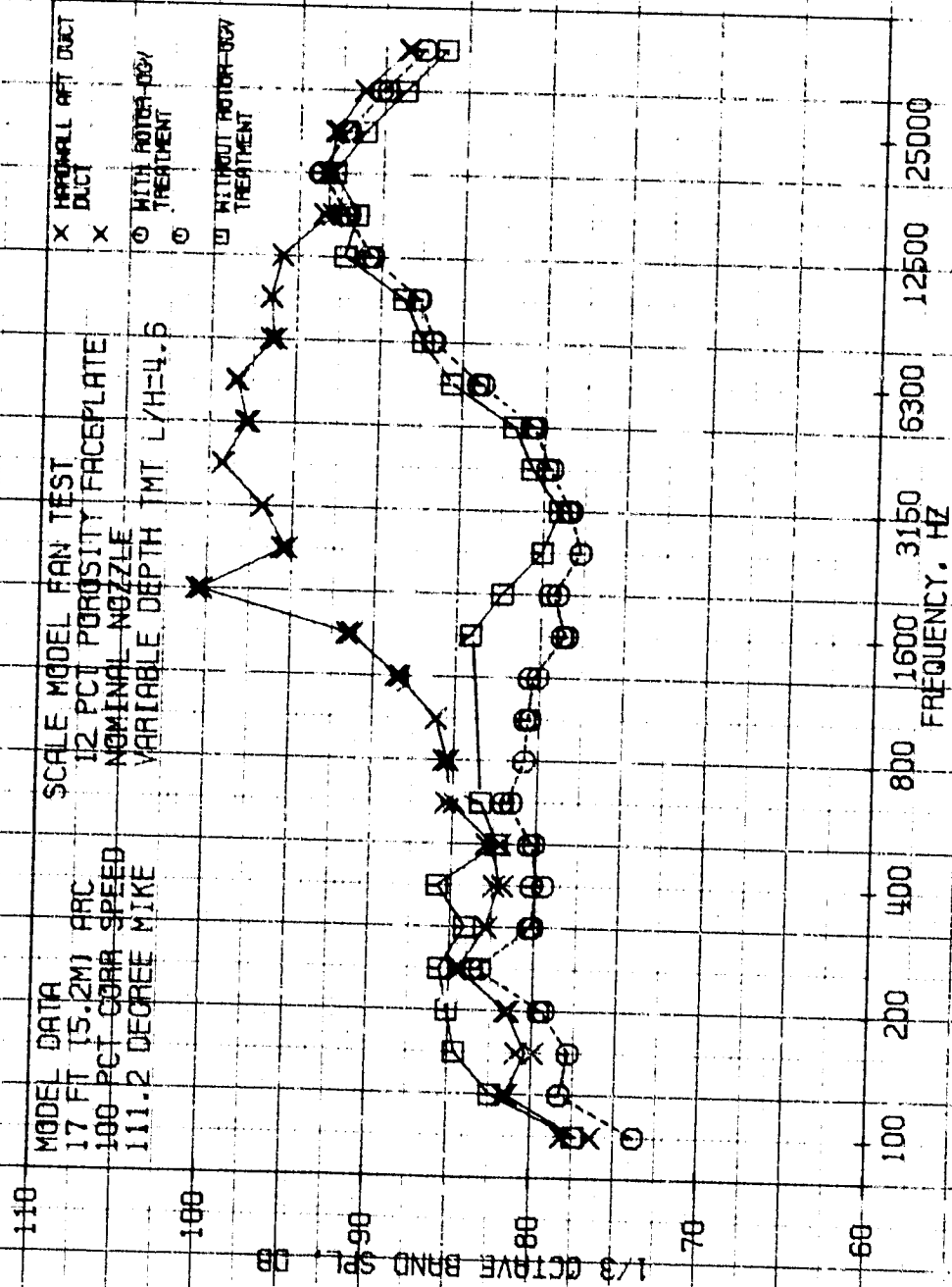
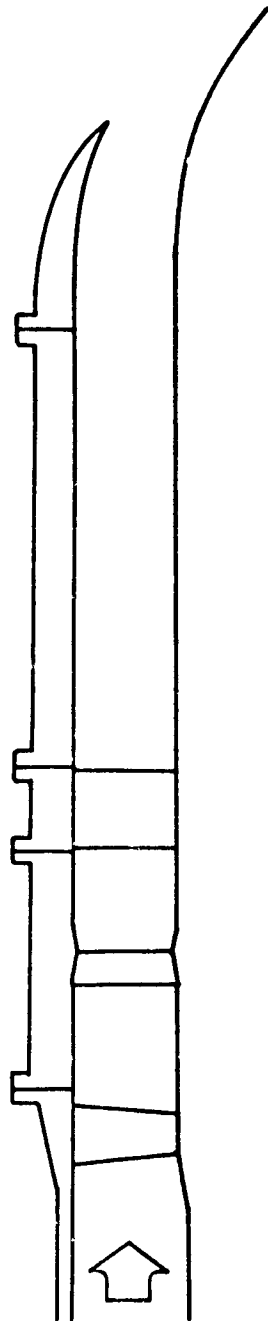


FIGURE 96

CONFIGURATION 18, HARDWALL



CONFIGURATION 8, 27 PERCENT POROSITY

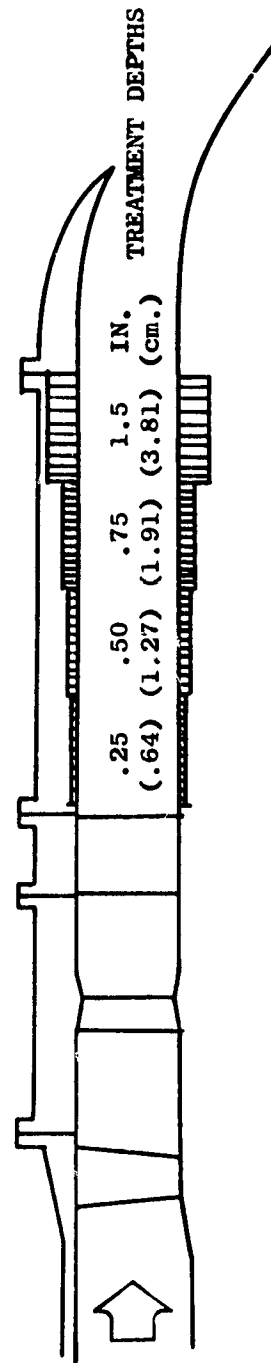


FIGURE 97 27 PERCENT POROSITY, VARIABLE DEPTH, THIN-TO-THICK CONFIGURATIONS



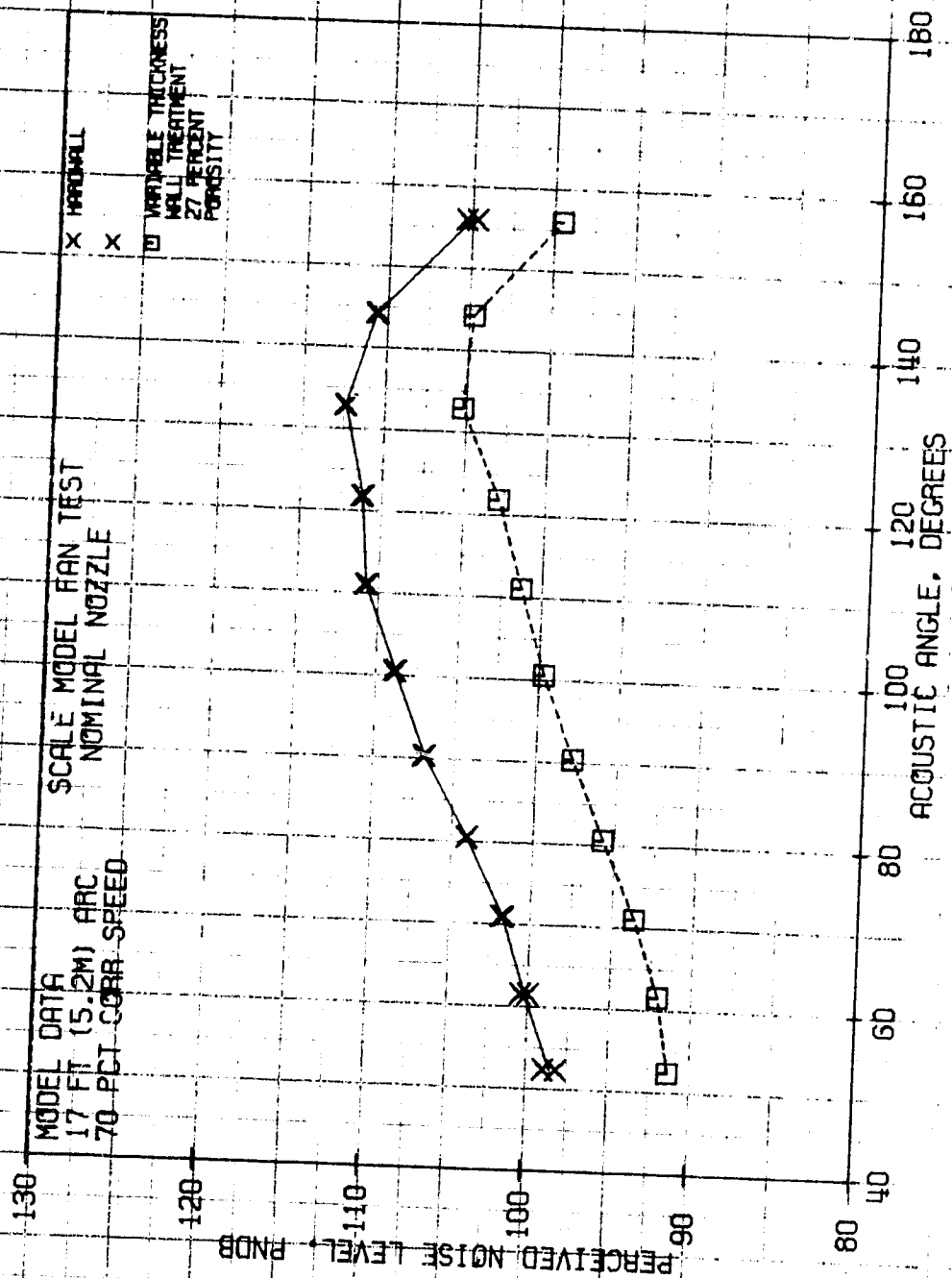


FIGURE 98

ORIGINAL PAGE IS  
OF POOR QUALITY

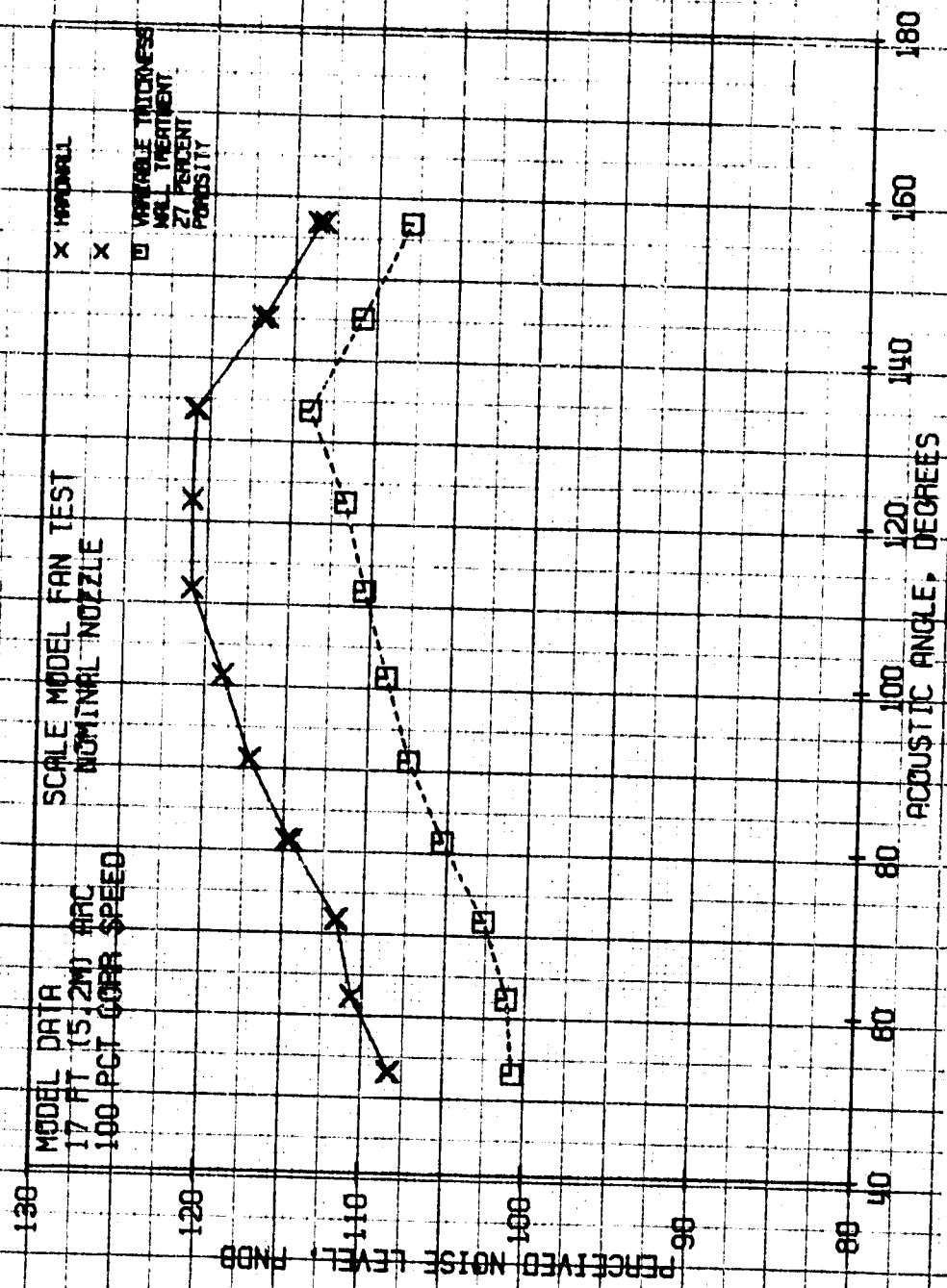


FIGURE 99

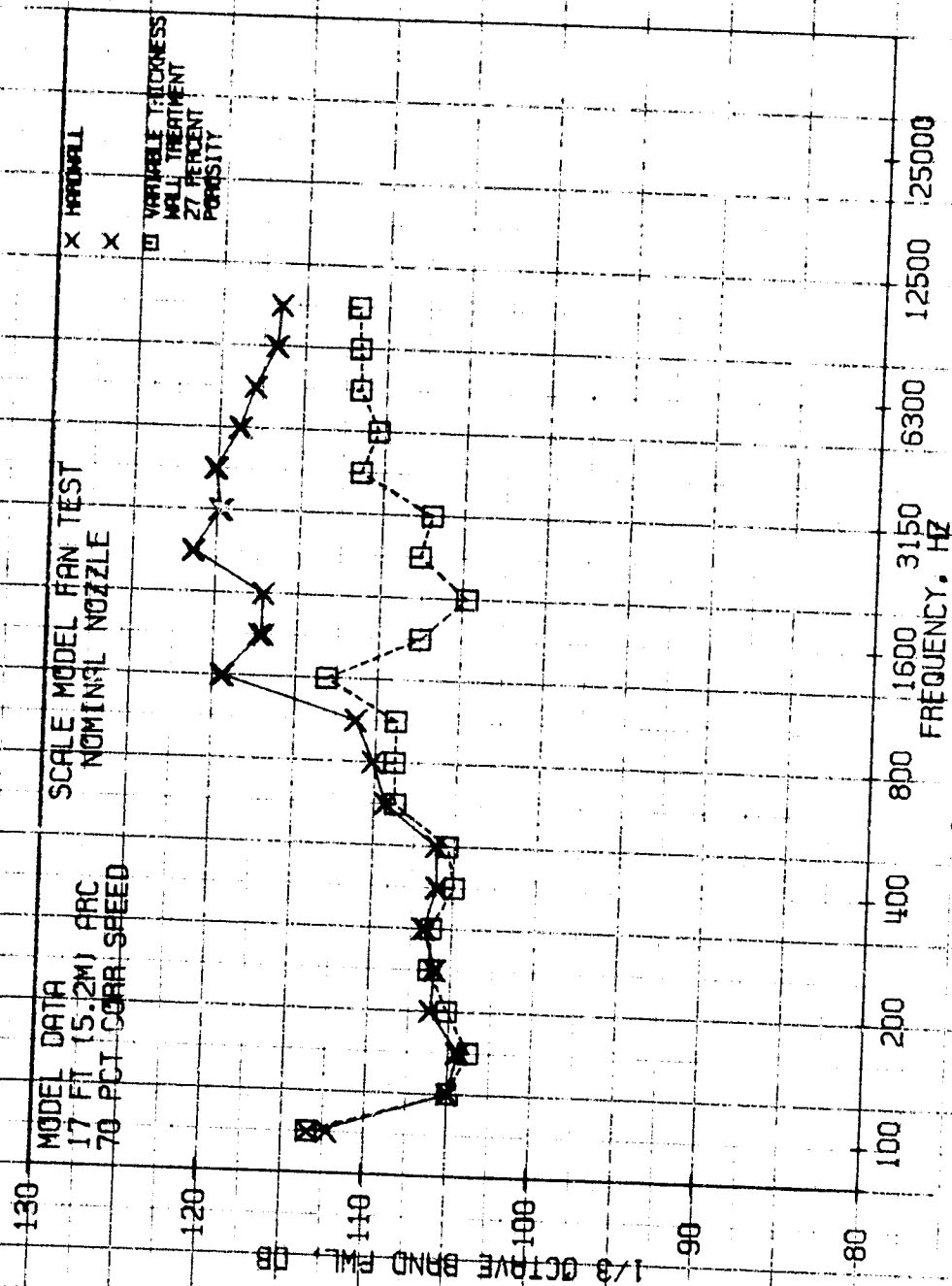


FIGURE 100

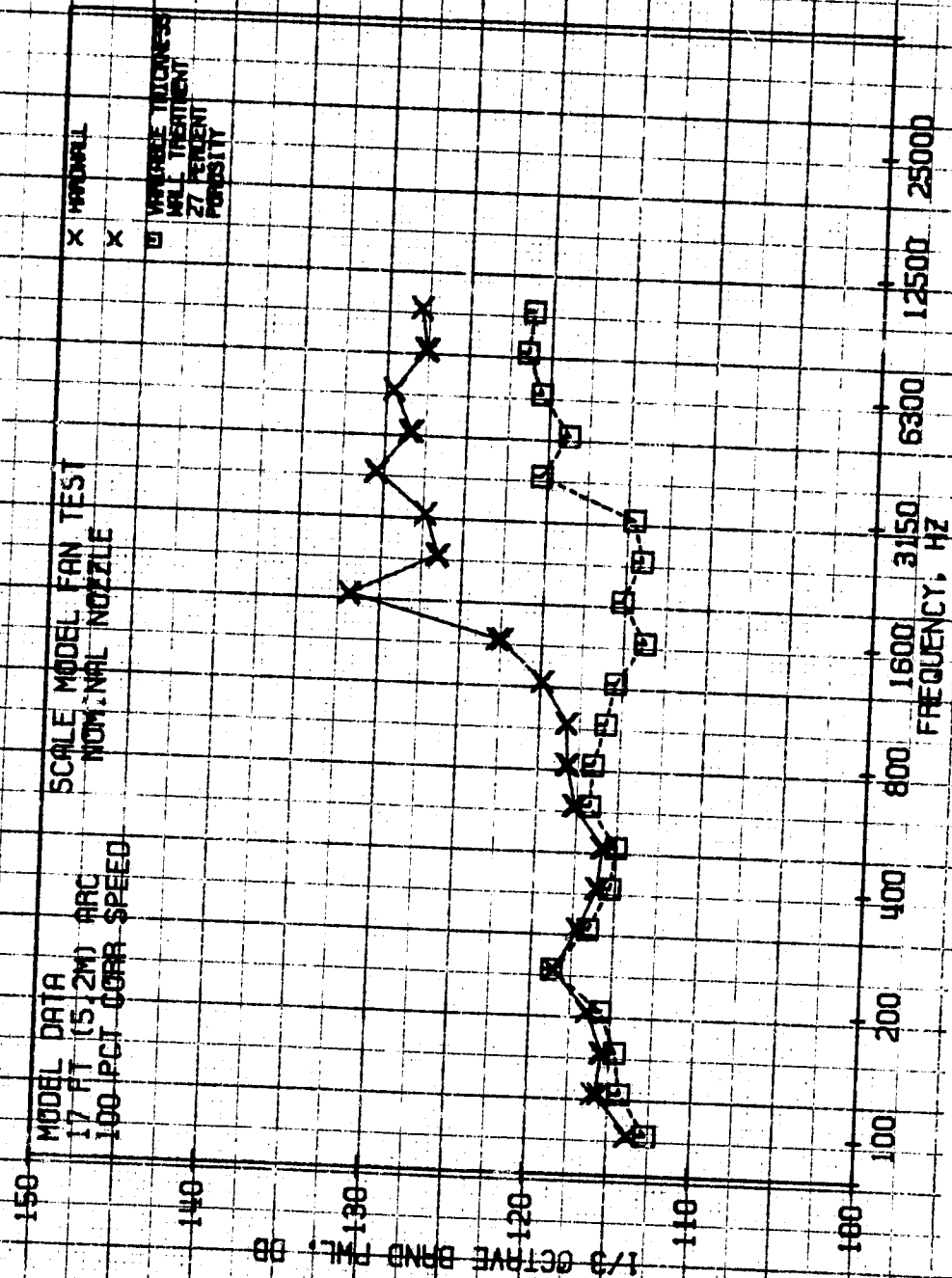


FIGURE 101

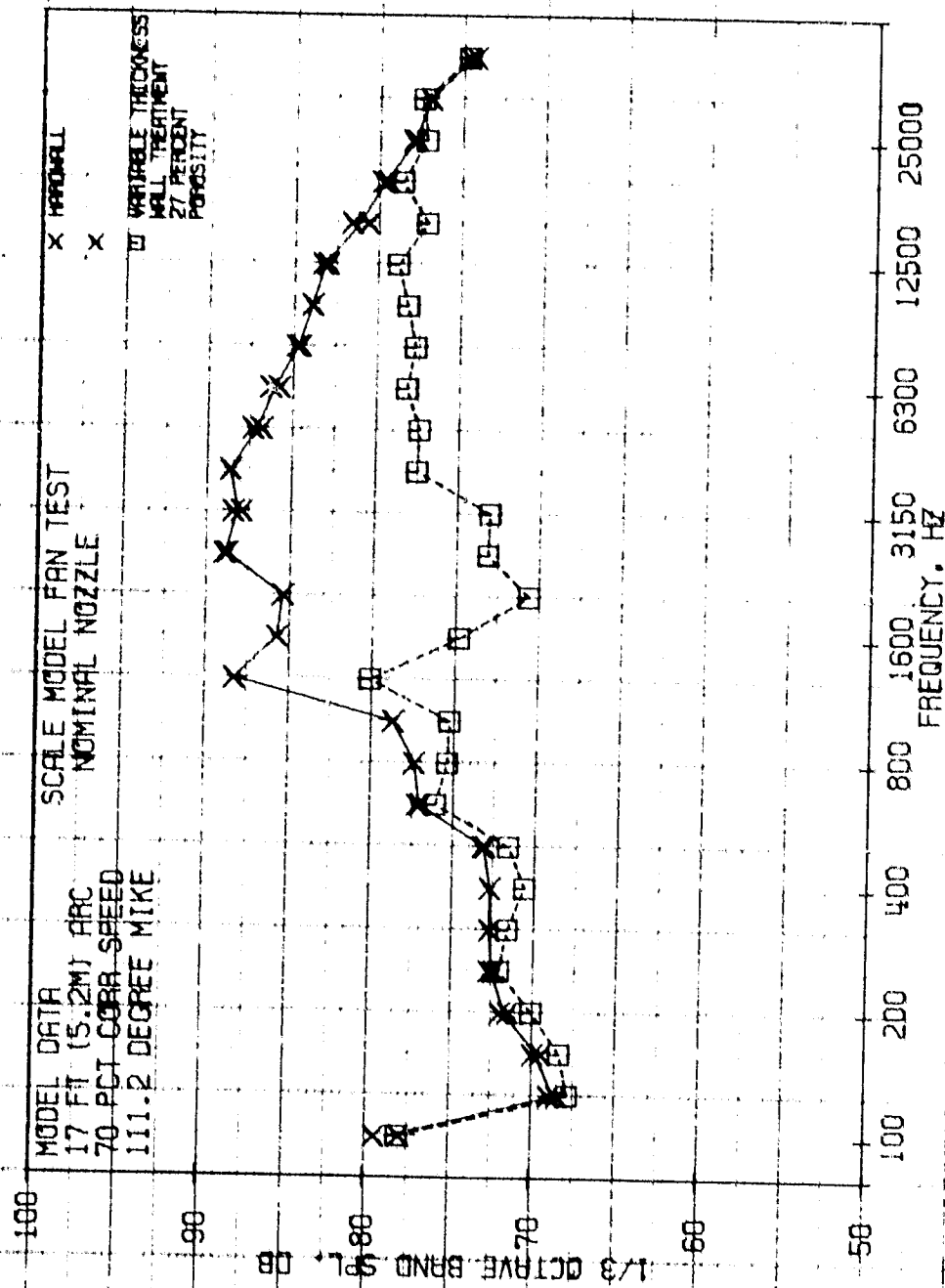


FIGURE 102

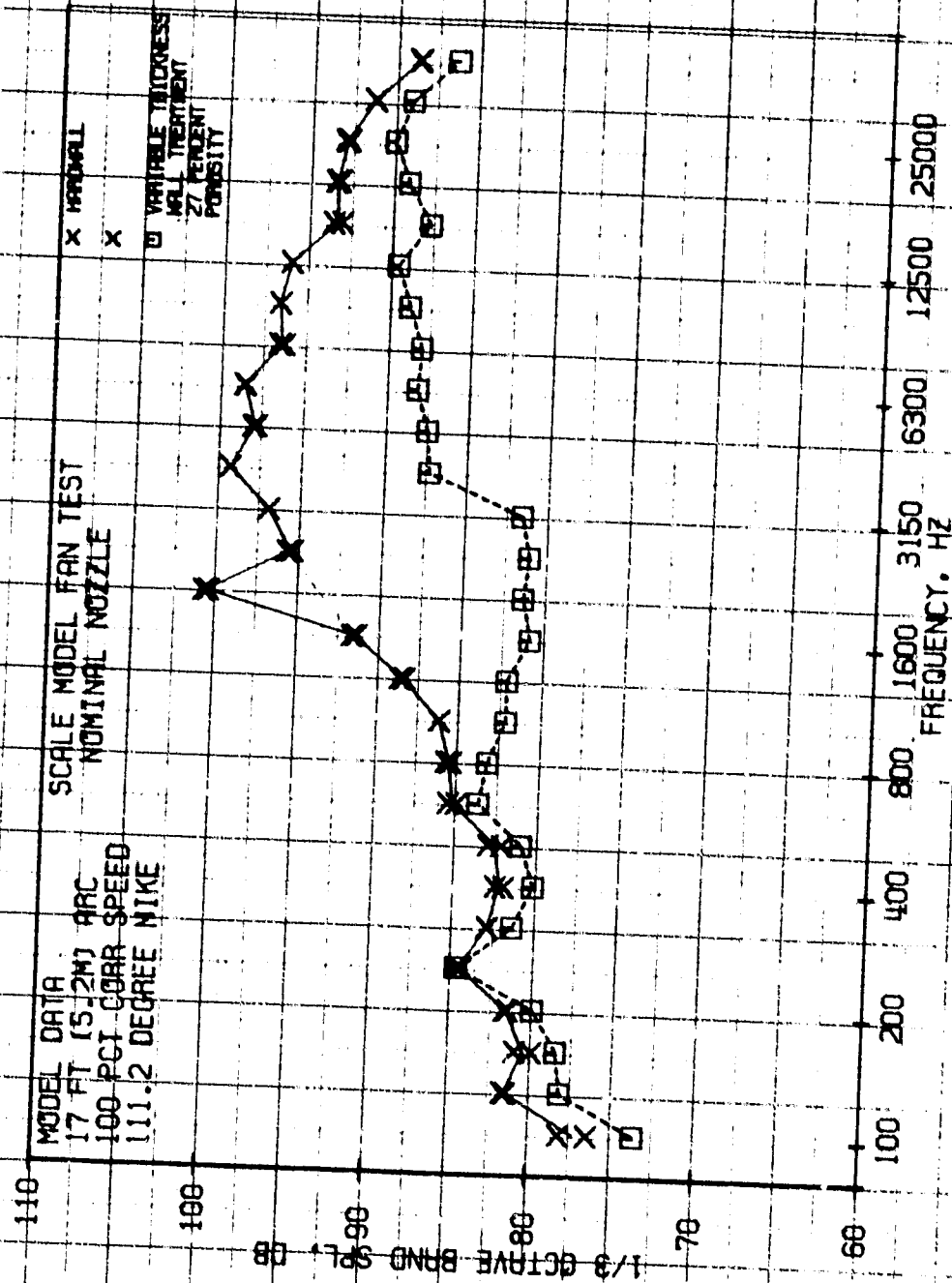


FIGURE 103

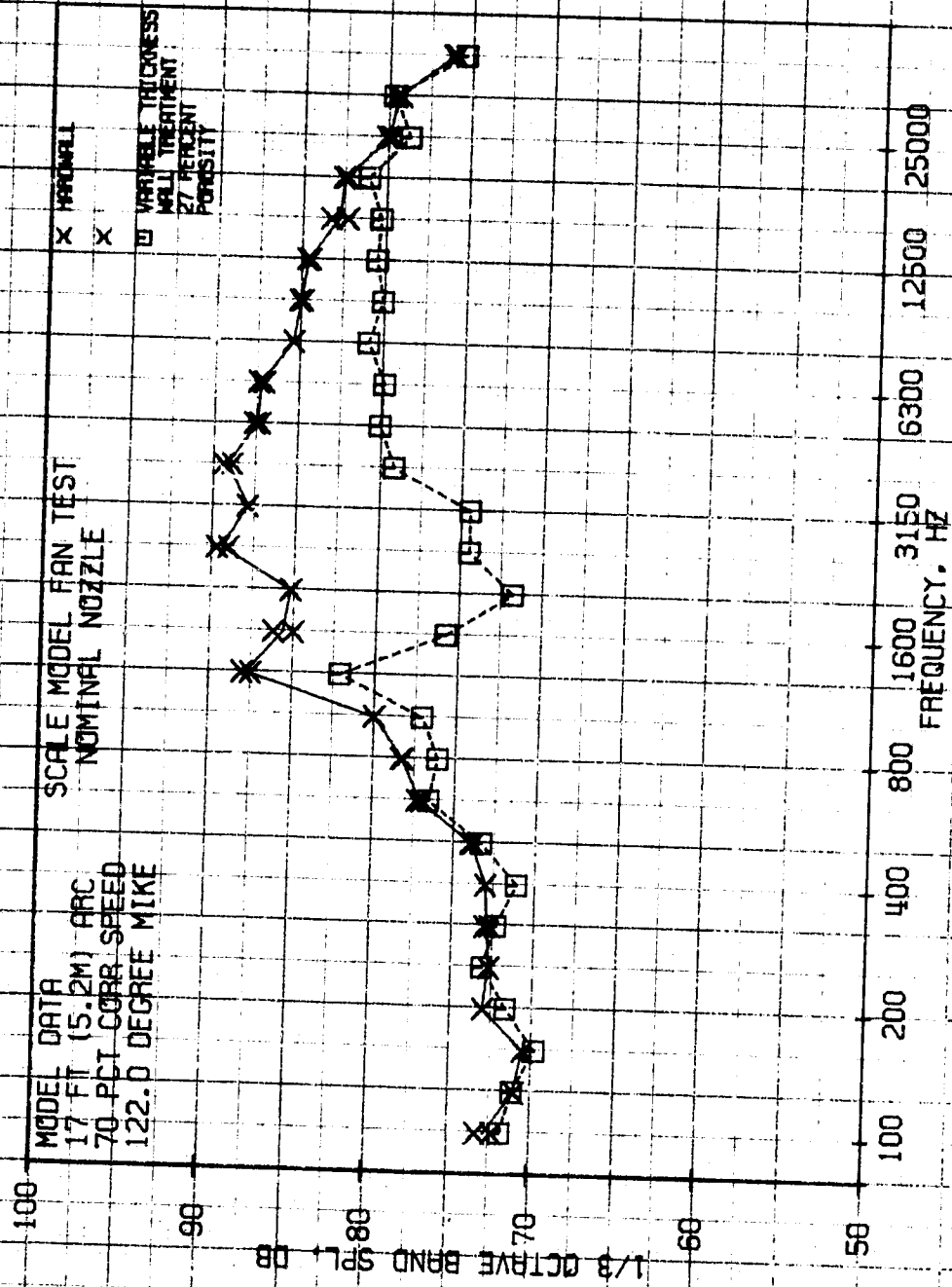


FIGURE 104

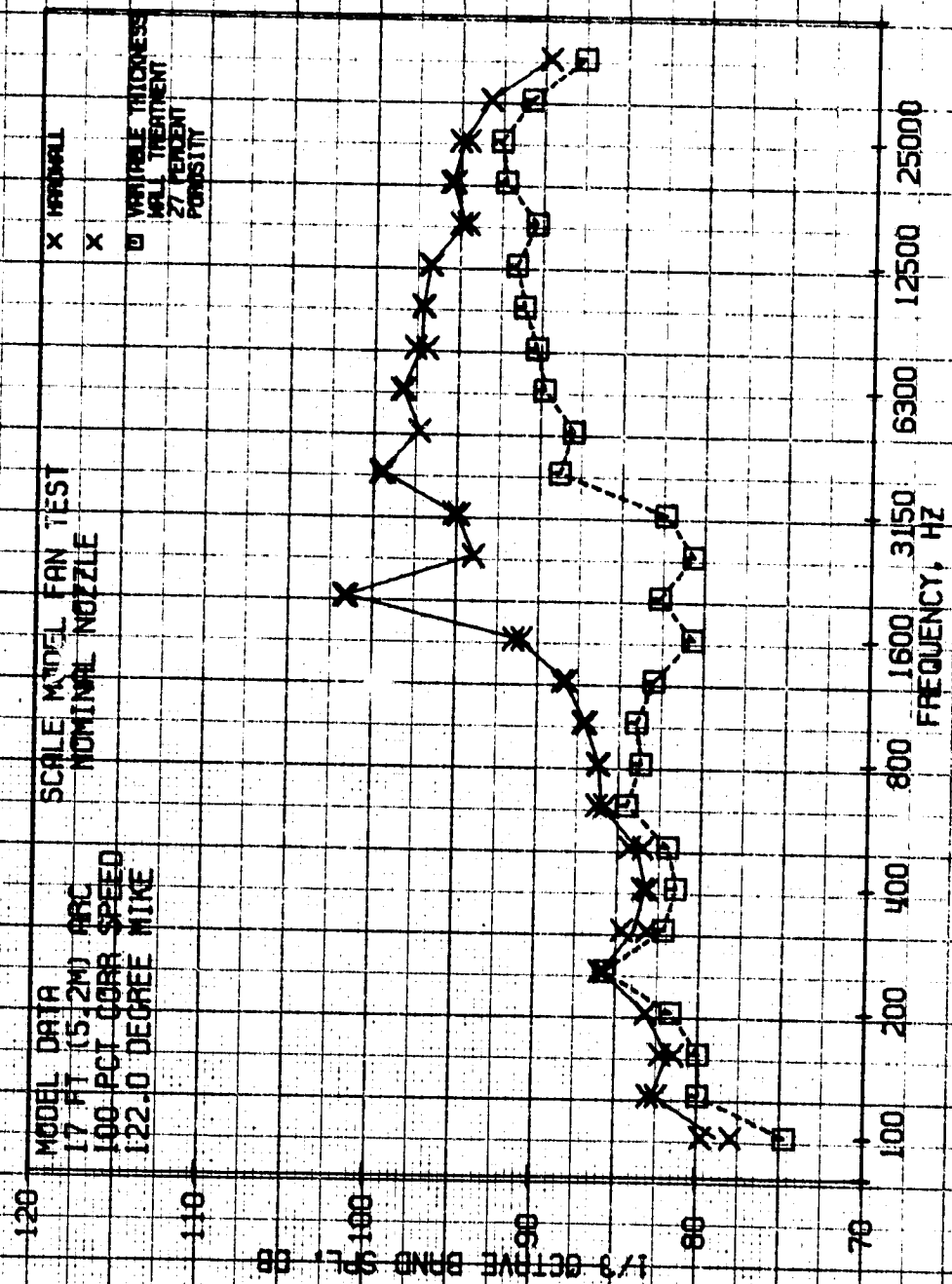
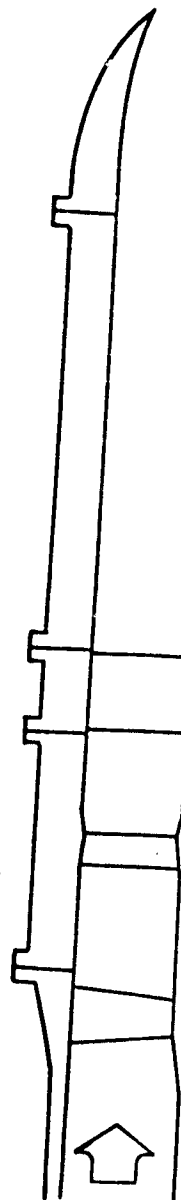


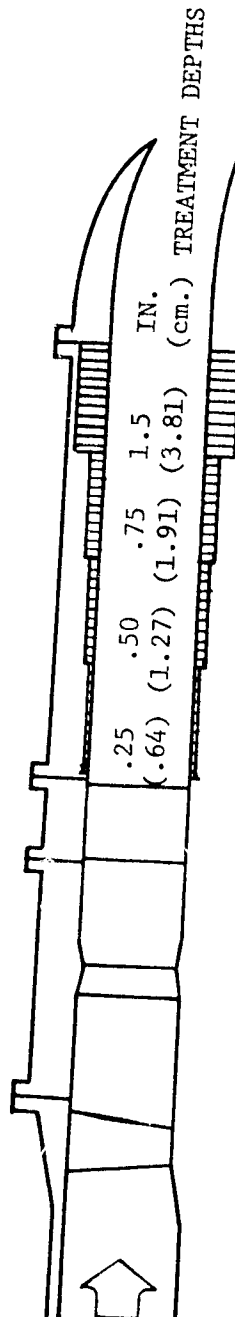
FIGURE 105



CONFIGURATION 18, HARDWALL



CONFIGURATION 8, POROSITY = 27%



CONFIGURATION 75-5, POROSITY = 27%

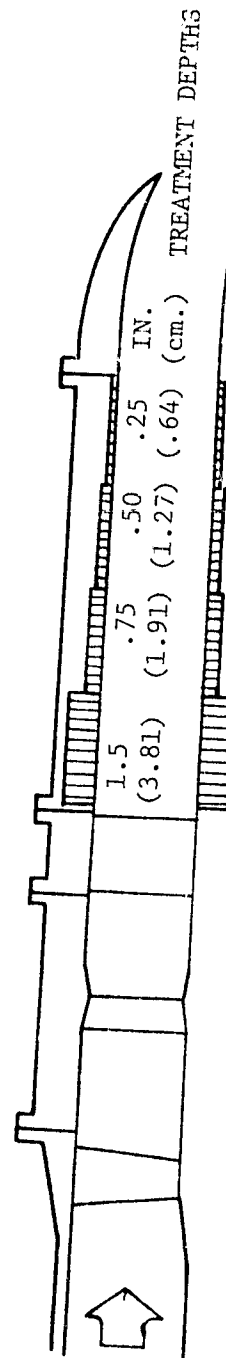


FIGURE 106. 27 PERCENT POROSITY THIN-TO-THICK AND THICK-TO-THIN CONFIGURATIONS

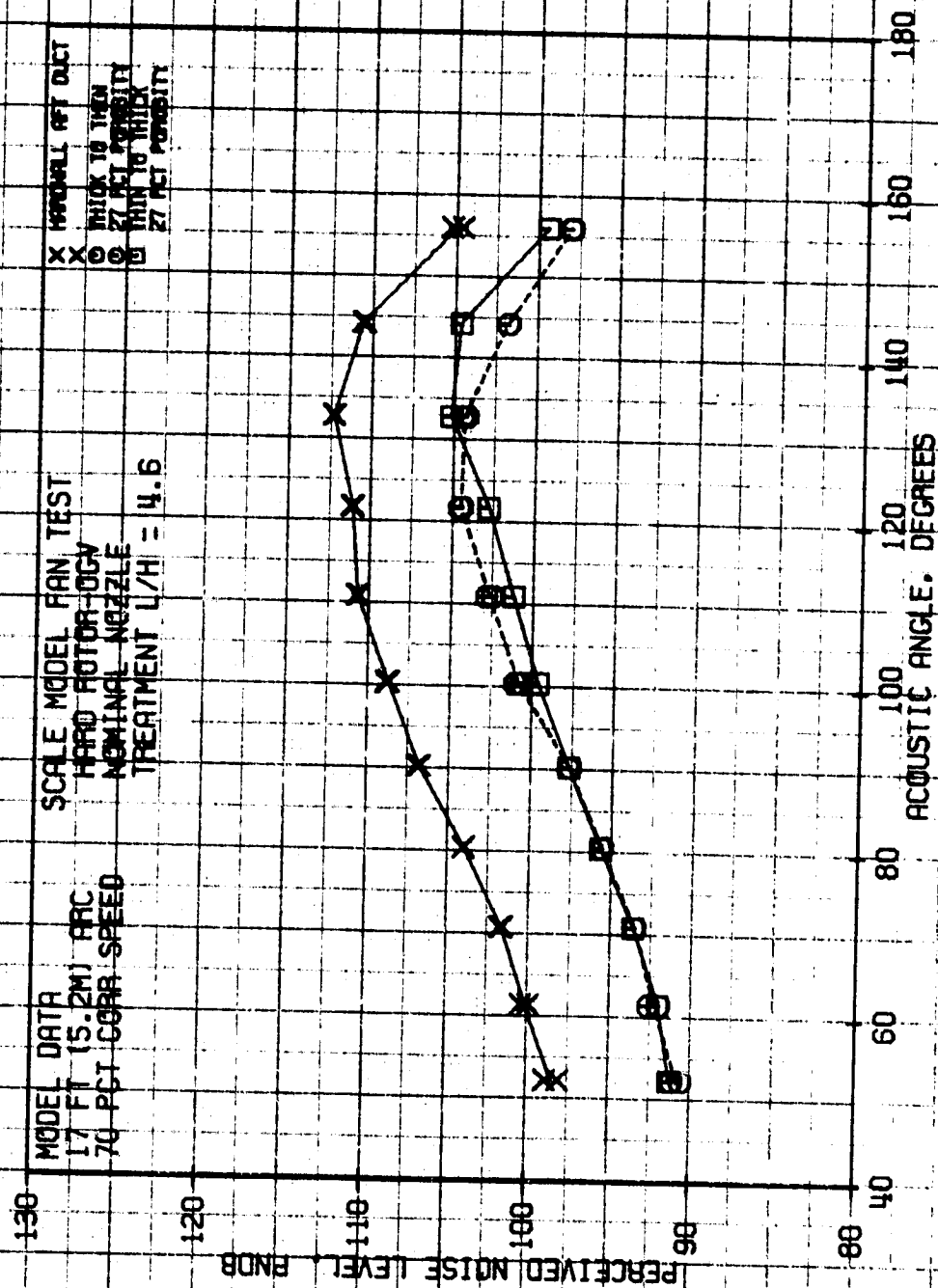


FIGURE 107

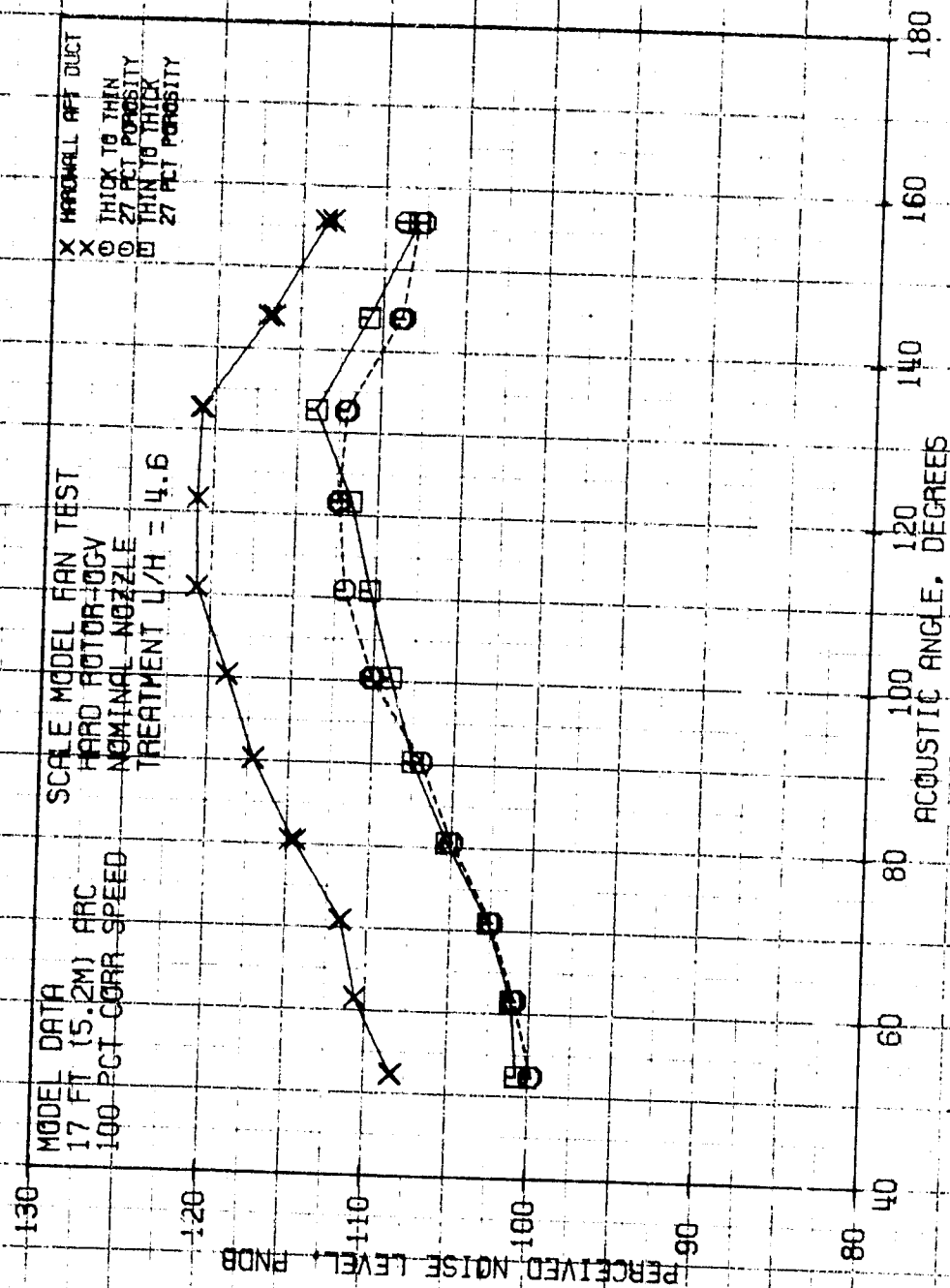


FIGURE 108

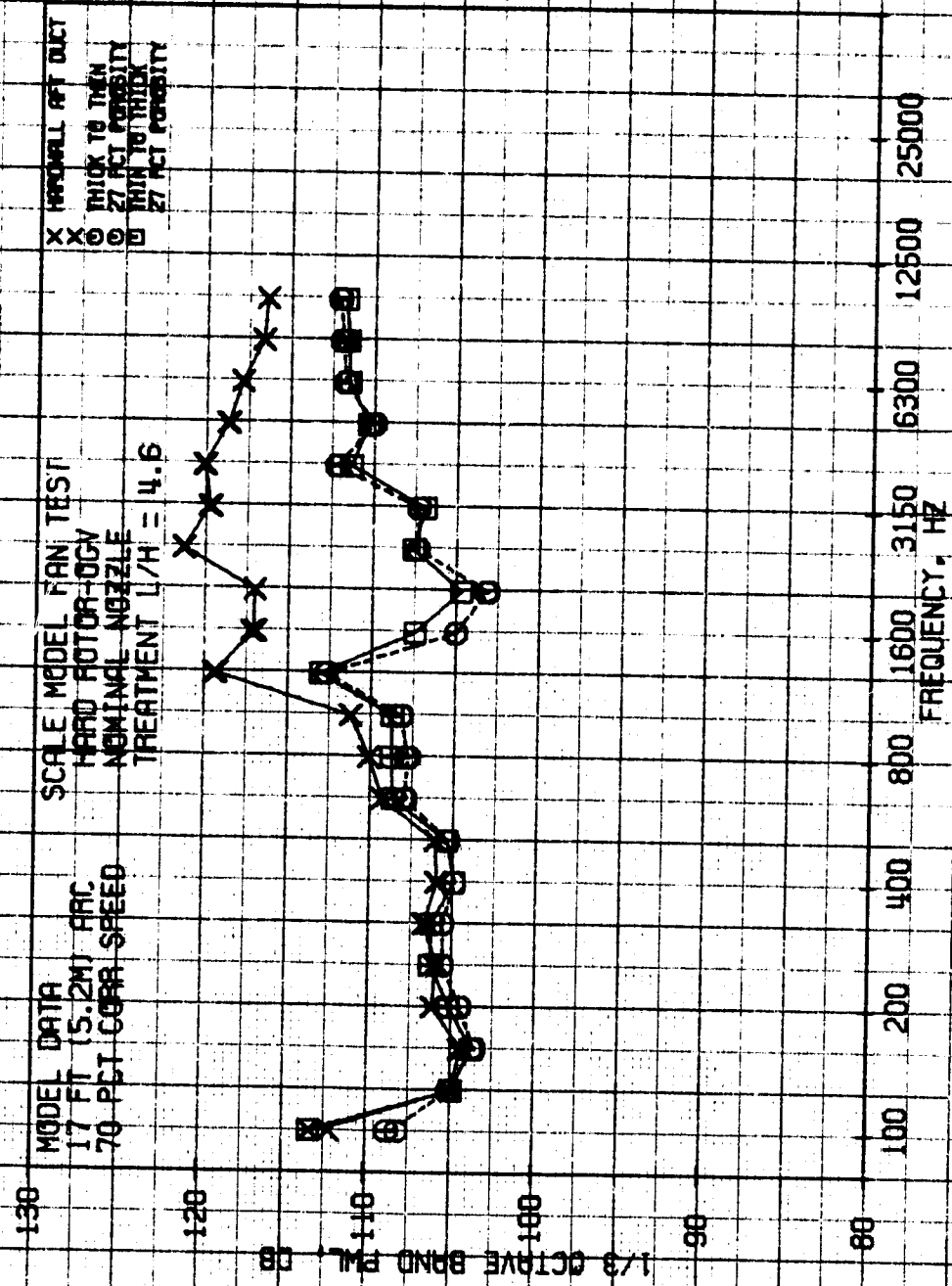


FIGURE 109

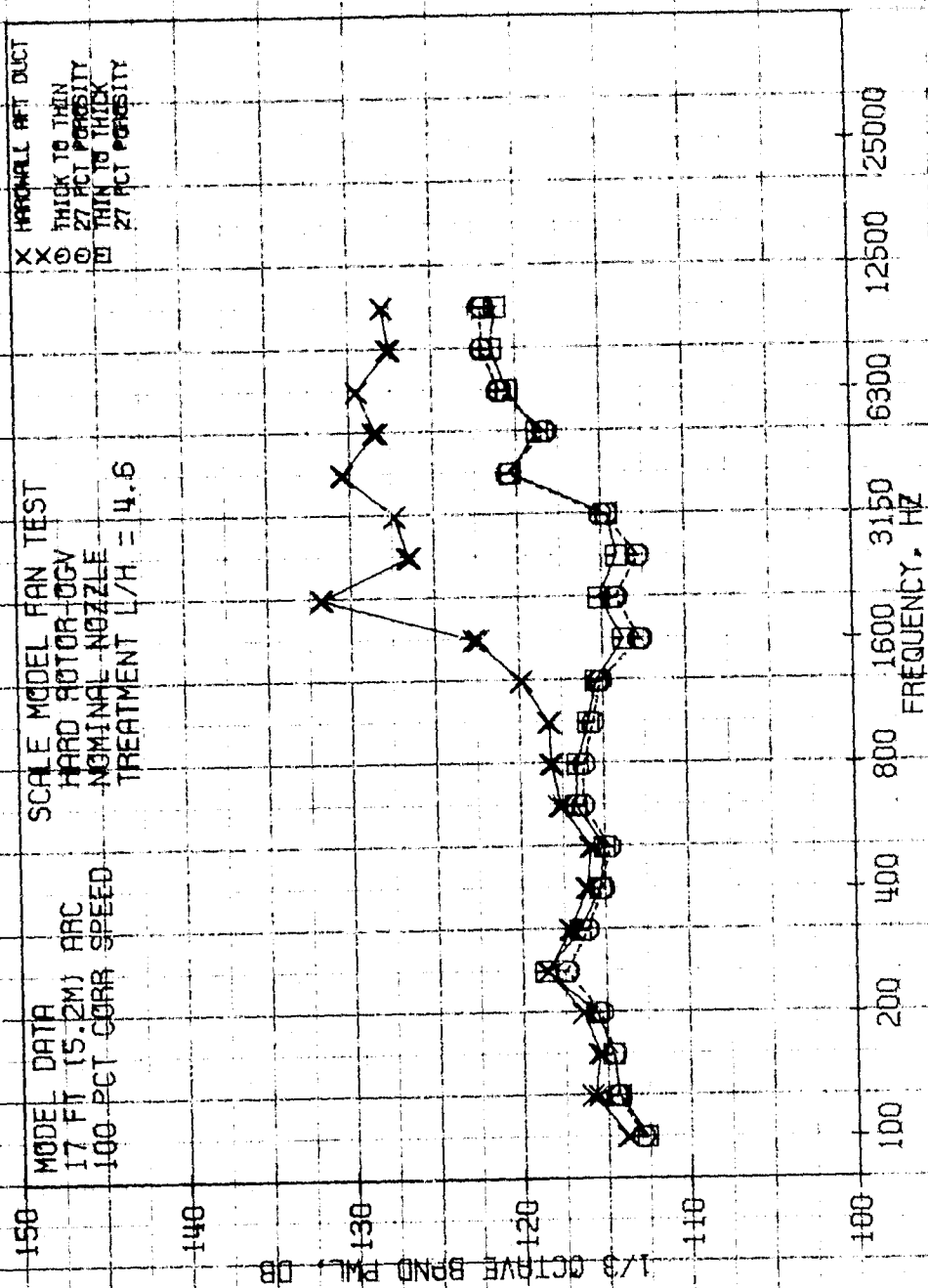


FIGURE 110

ORIGINAL PAGE IS  
OF POOR QUALITY

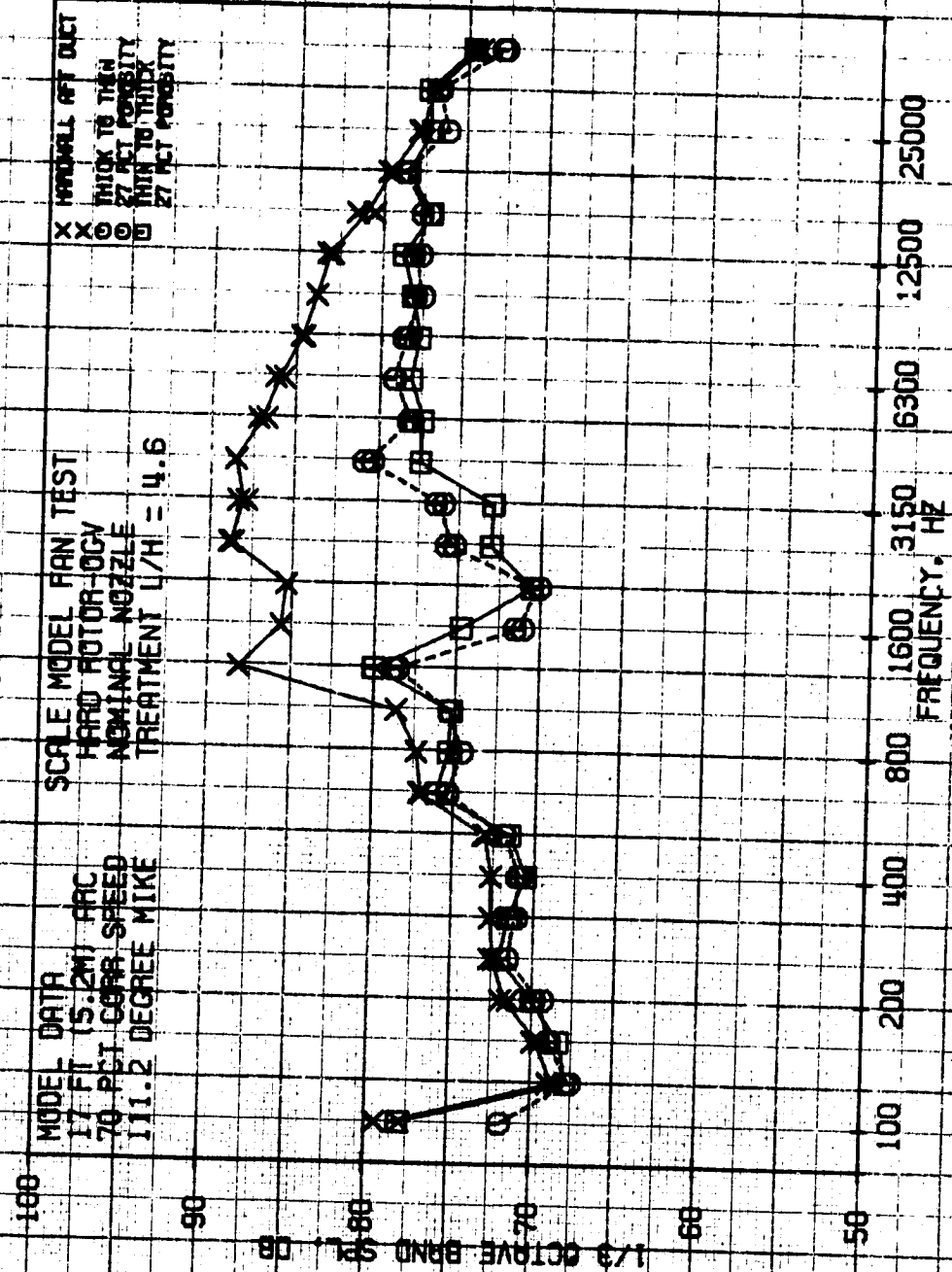


FIGURE III

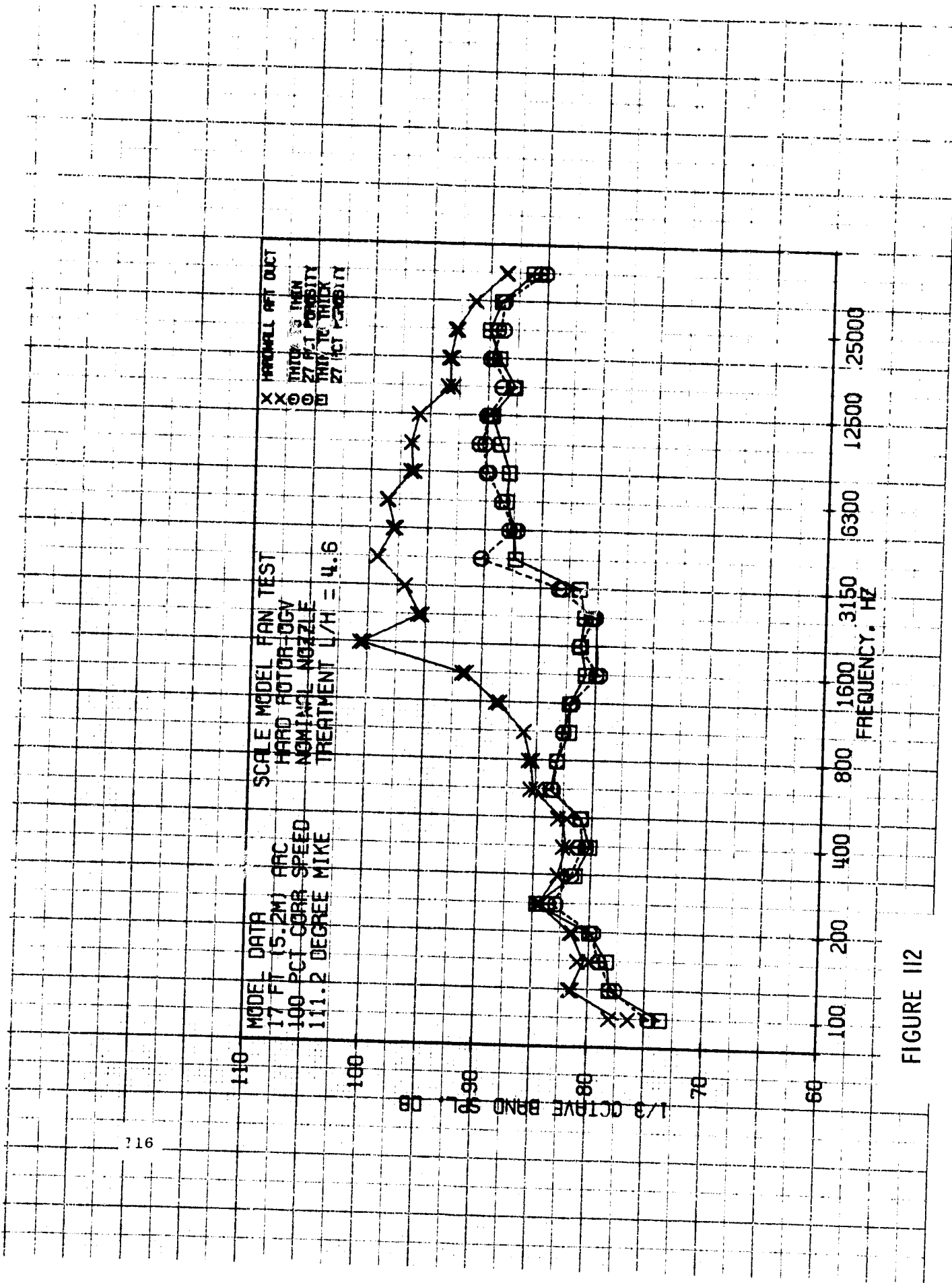


FIGURE 112

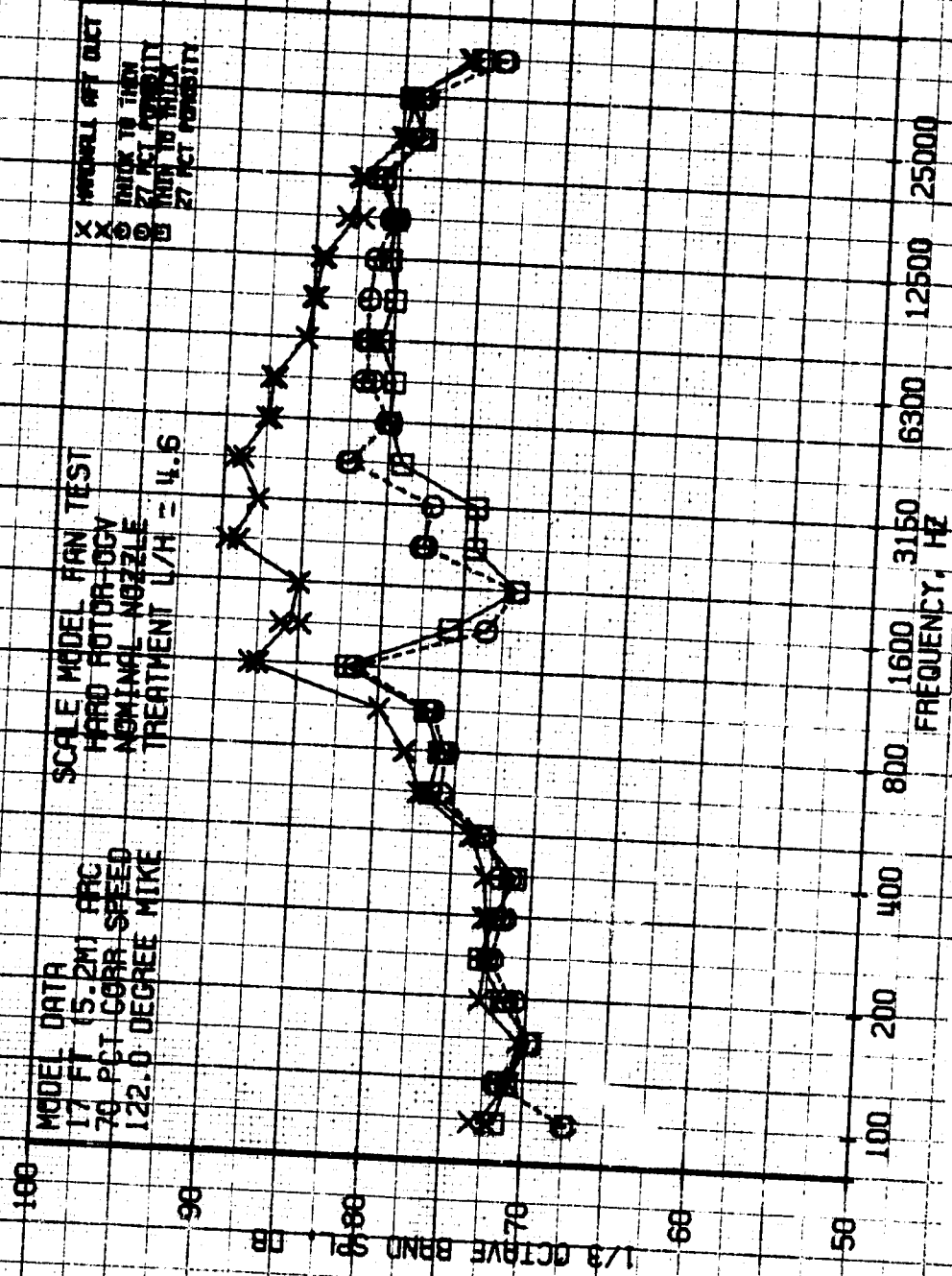
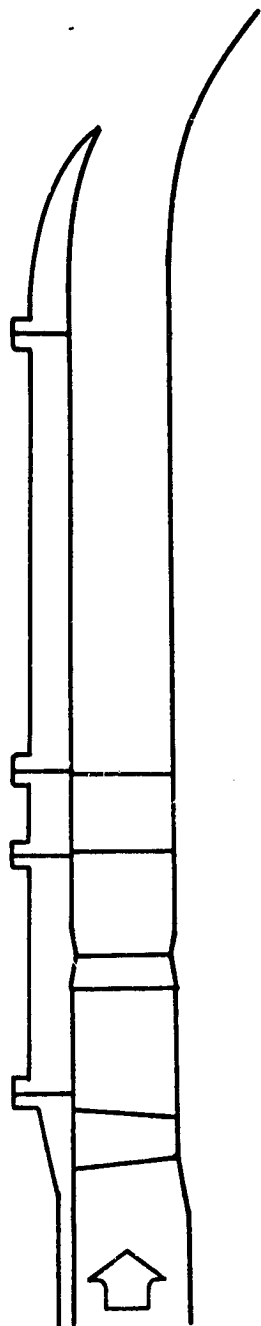


FIGURE 113





CONFIGURATION 18, HARDWALL



CONFIGURATION 9, 27 PERCENT POROSITY

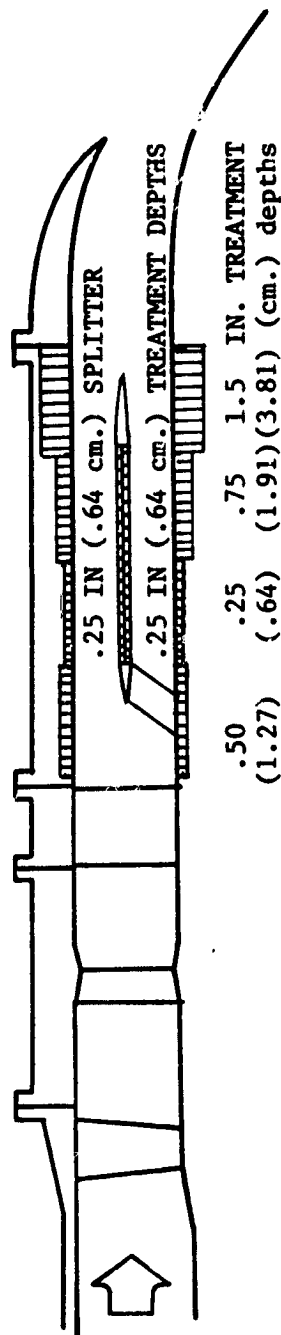


FIGURE 115 SPLITTER, NOMINAL NOZZLE CONFIGURATION

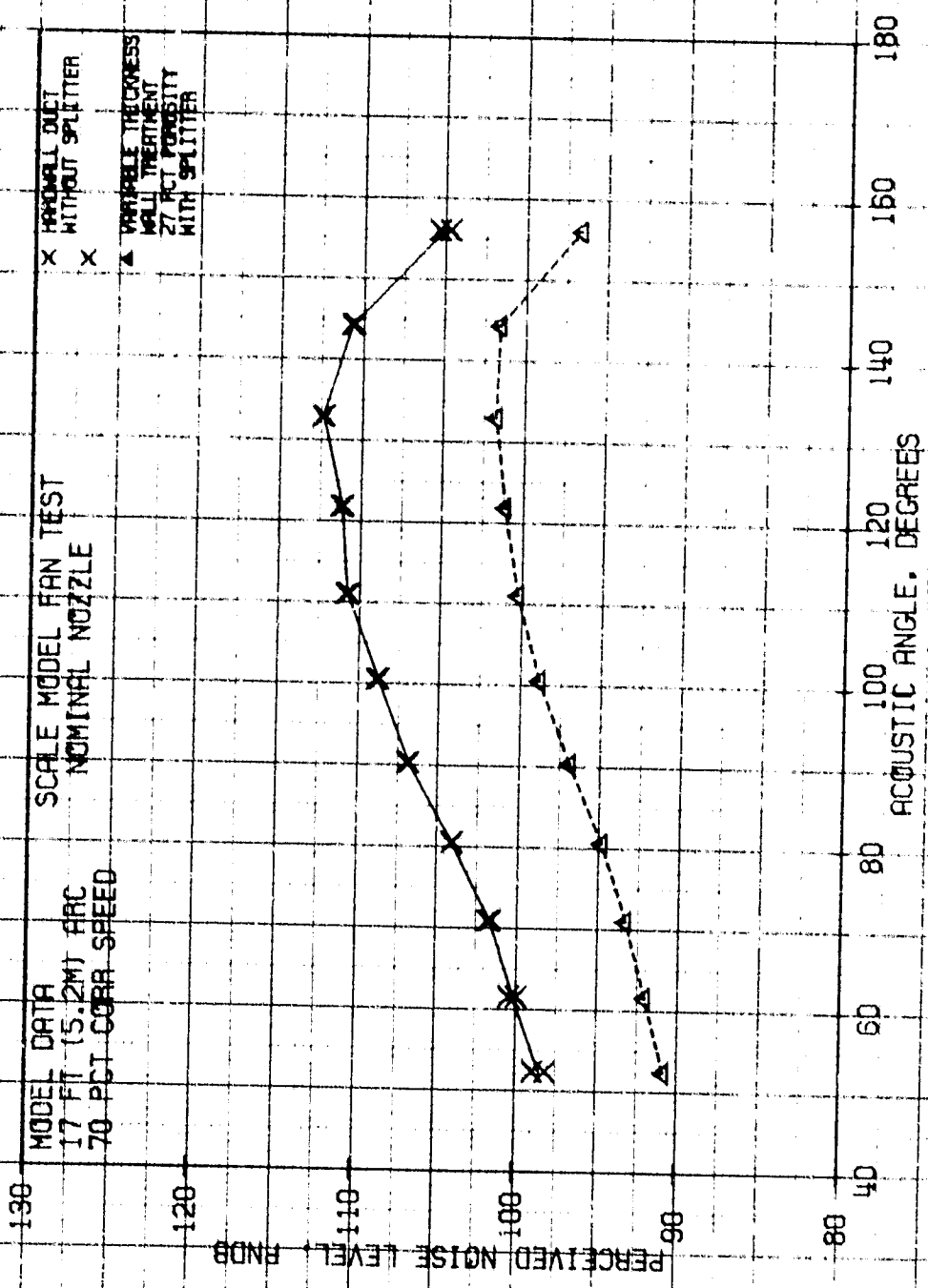


FIGURE 116

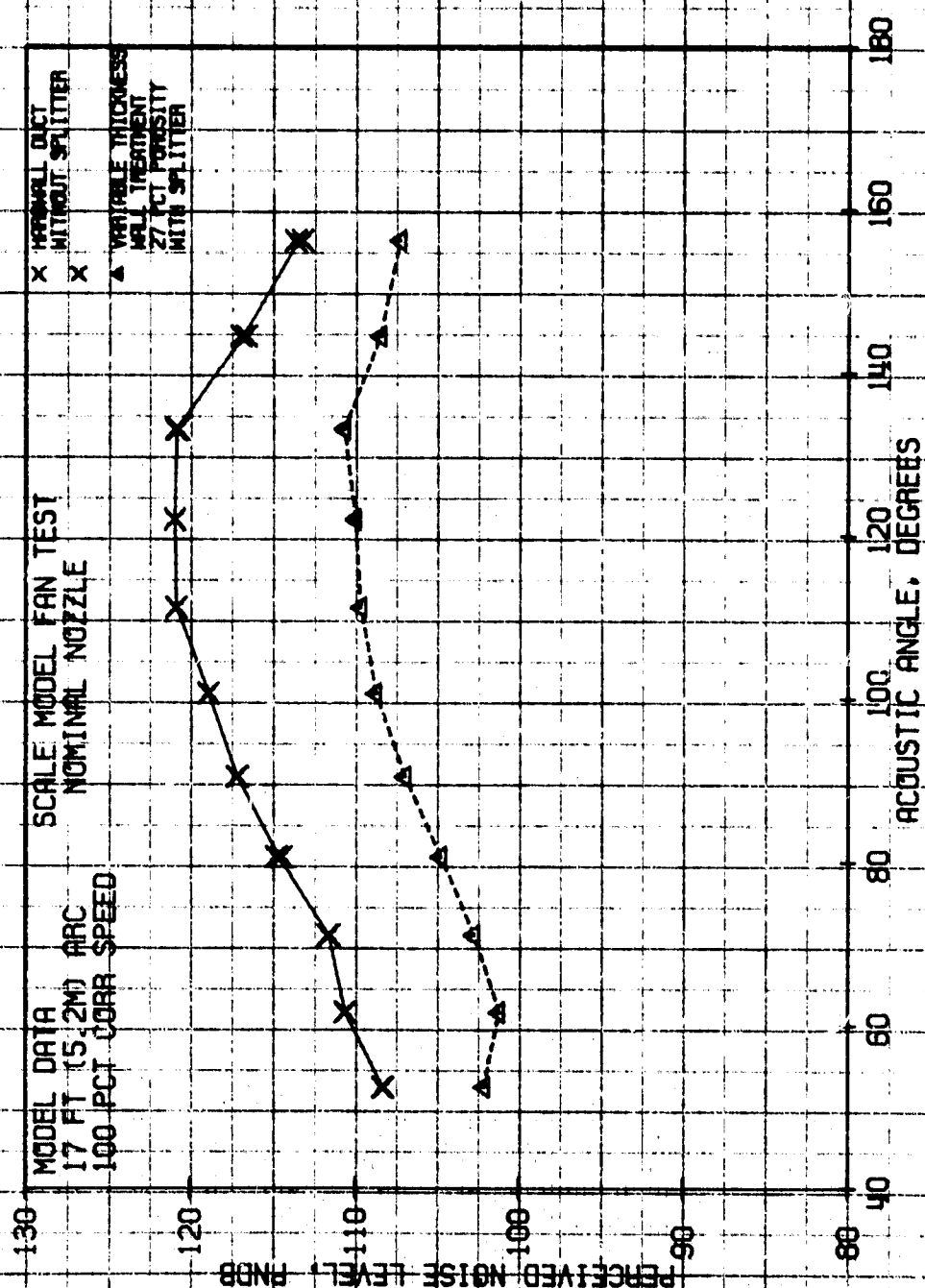


FIGURE 117

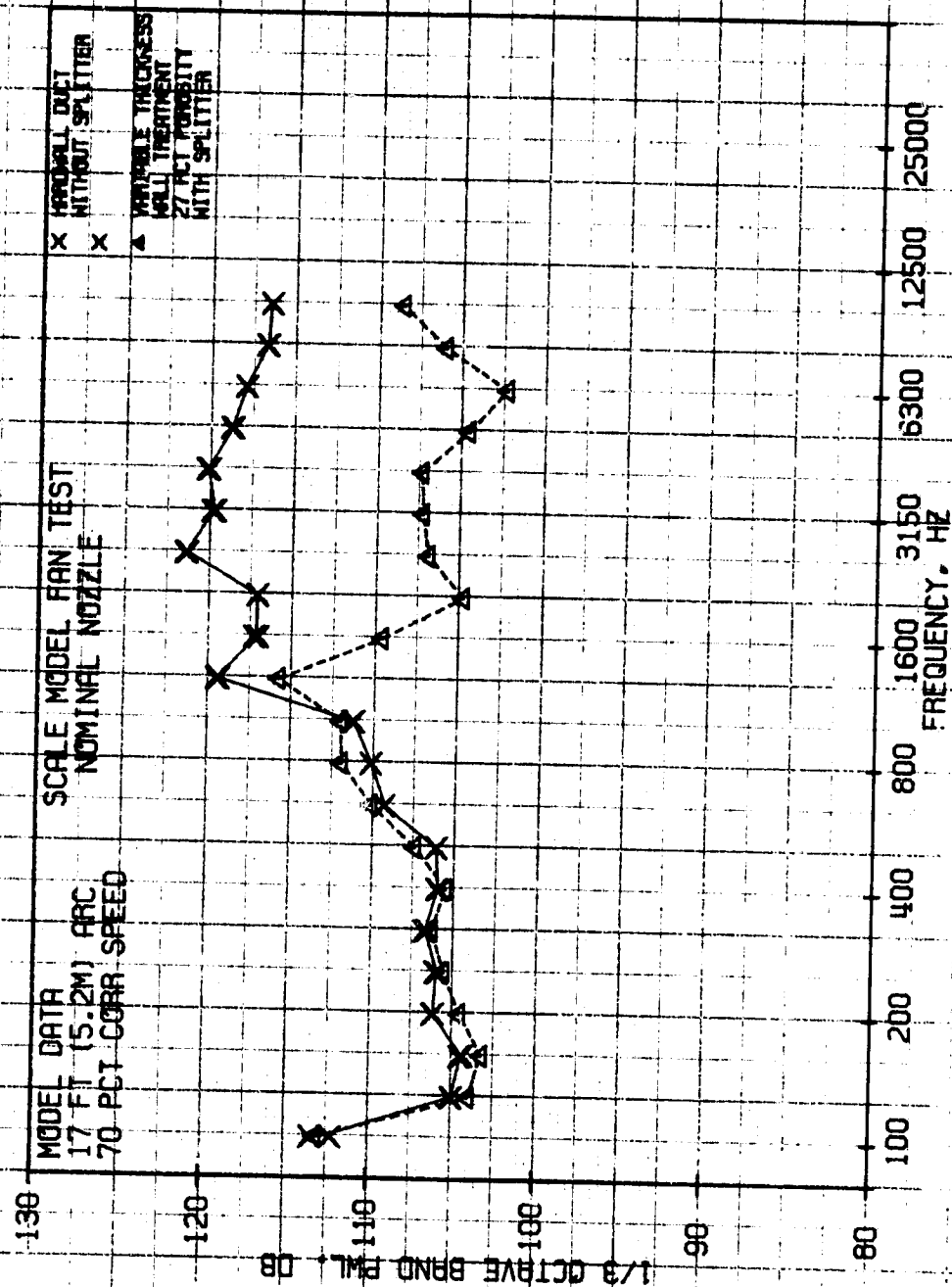


FIGURE 118

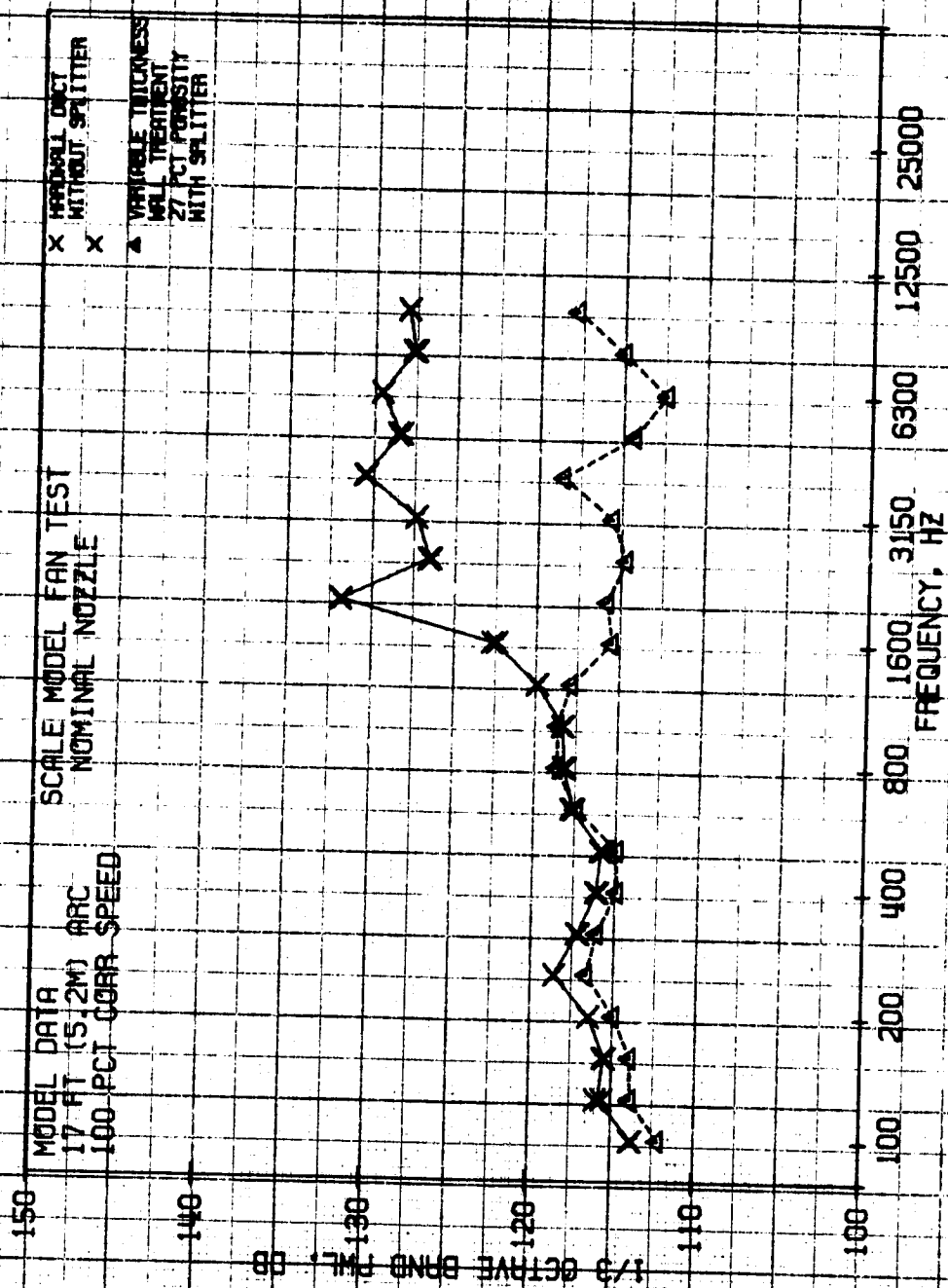


FIGURE 119

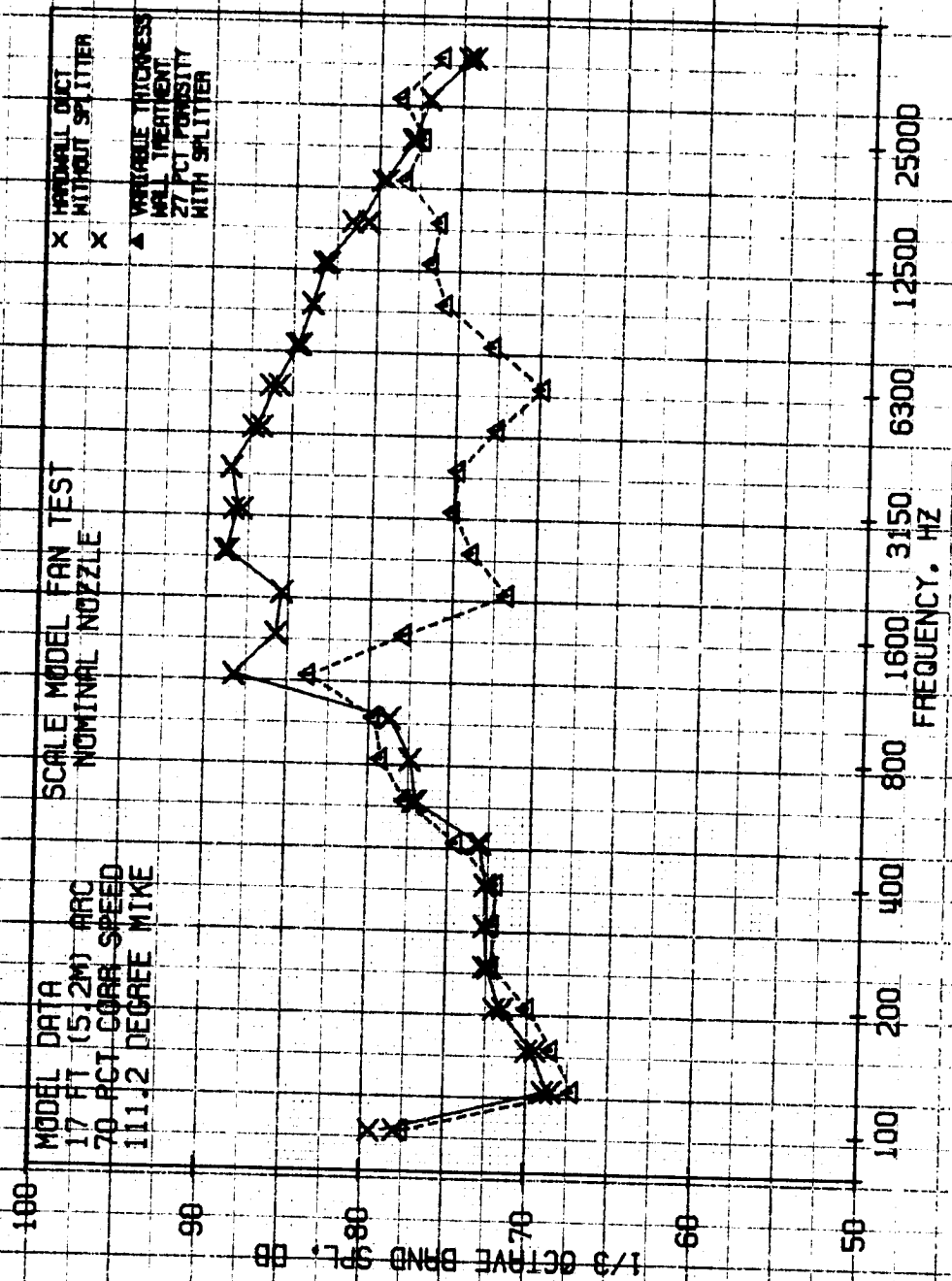


FIGURE 120

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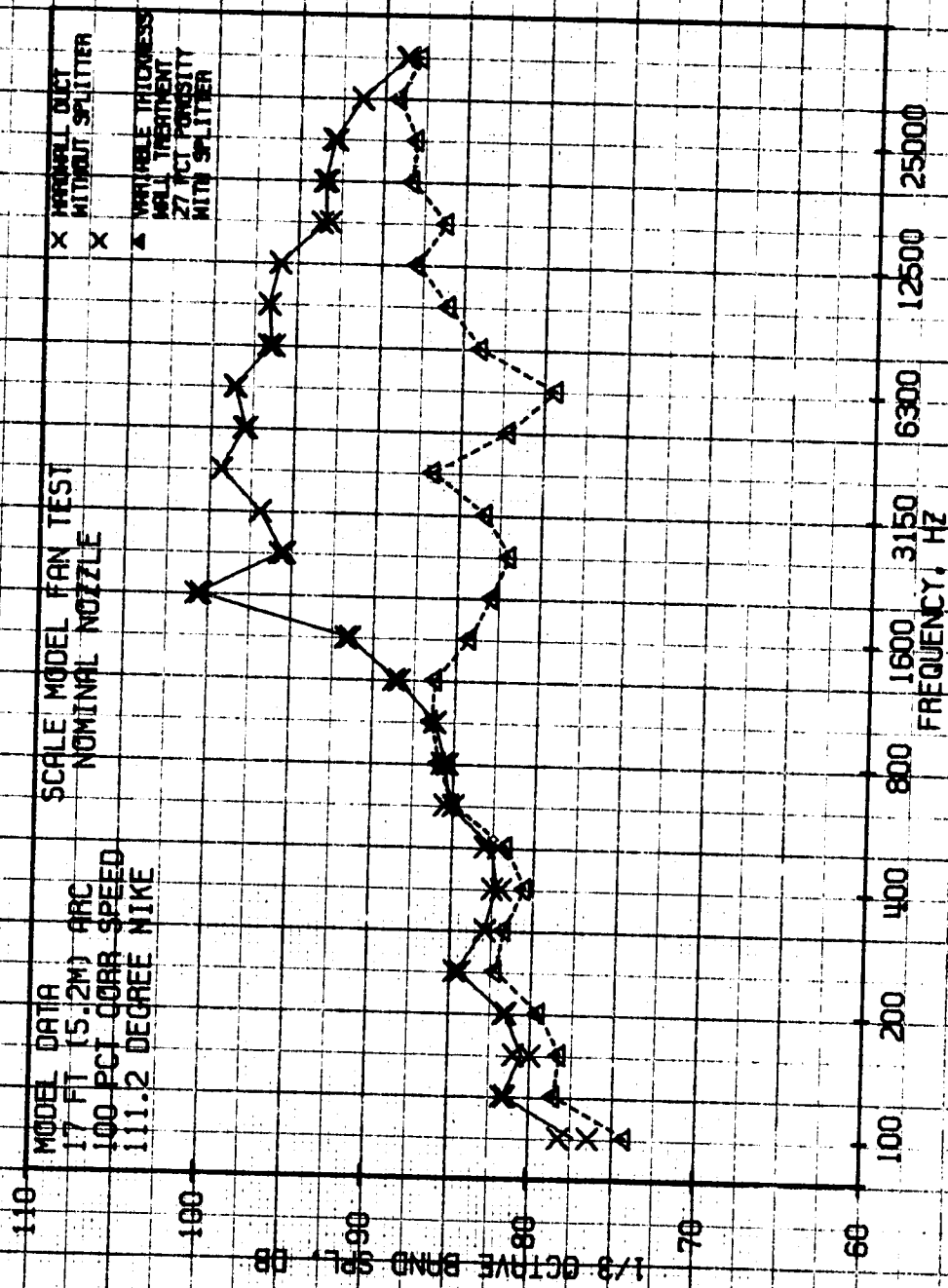


FIGURE 121



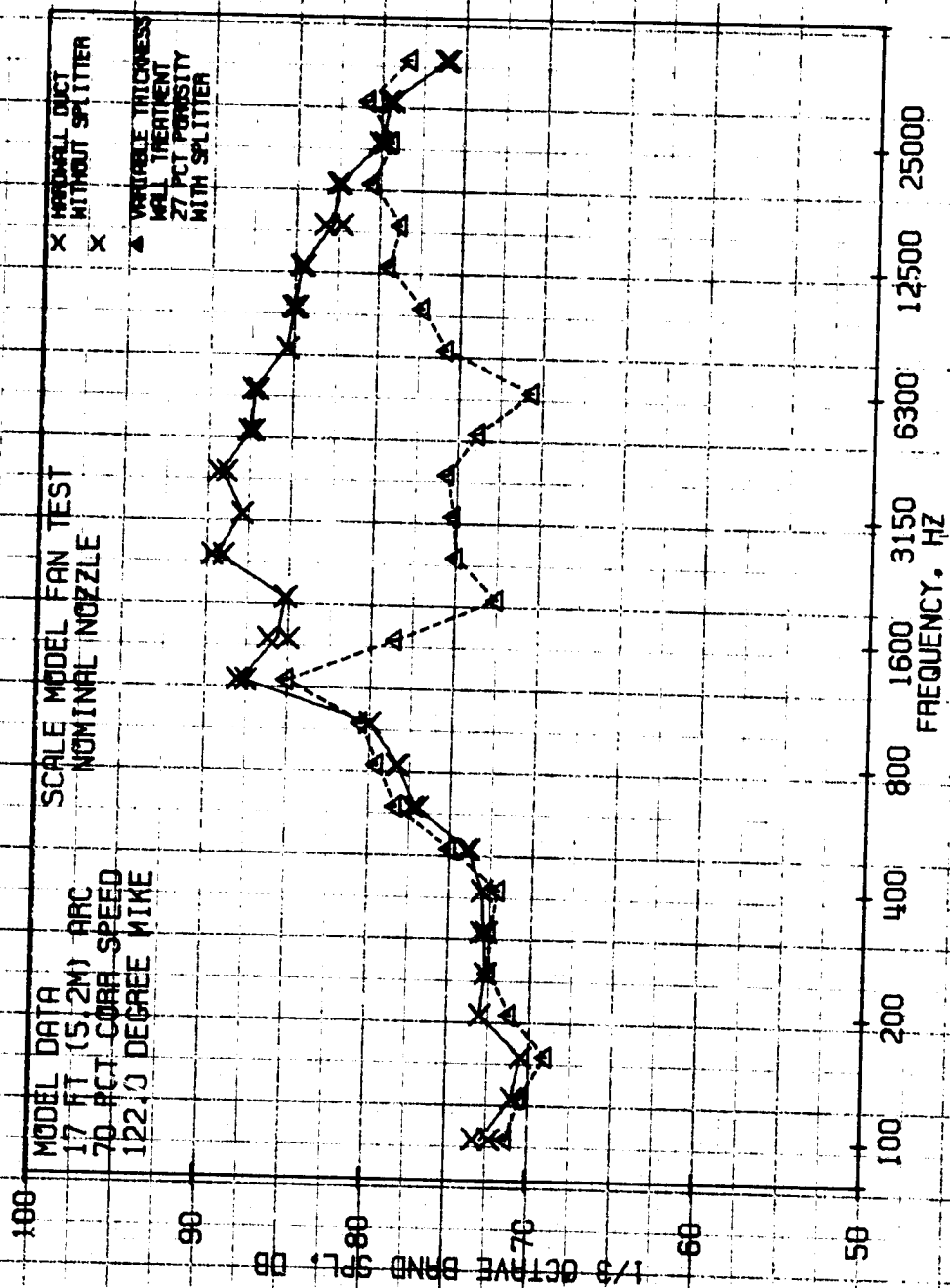


FIGURE 122

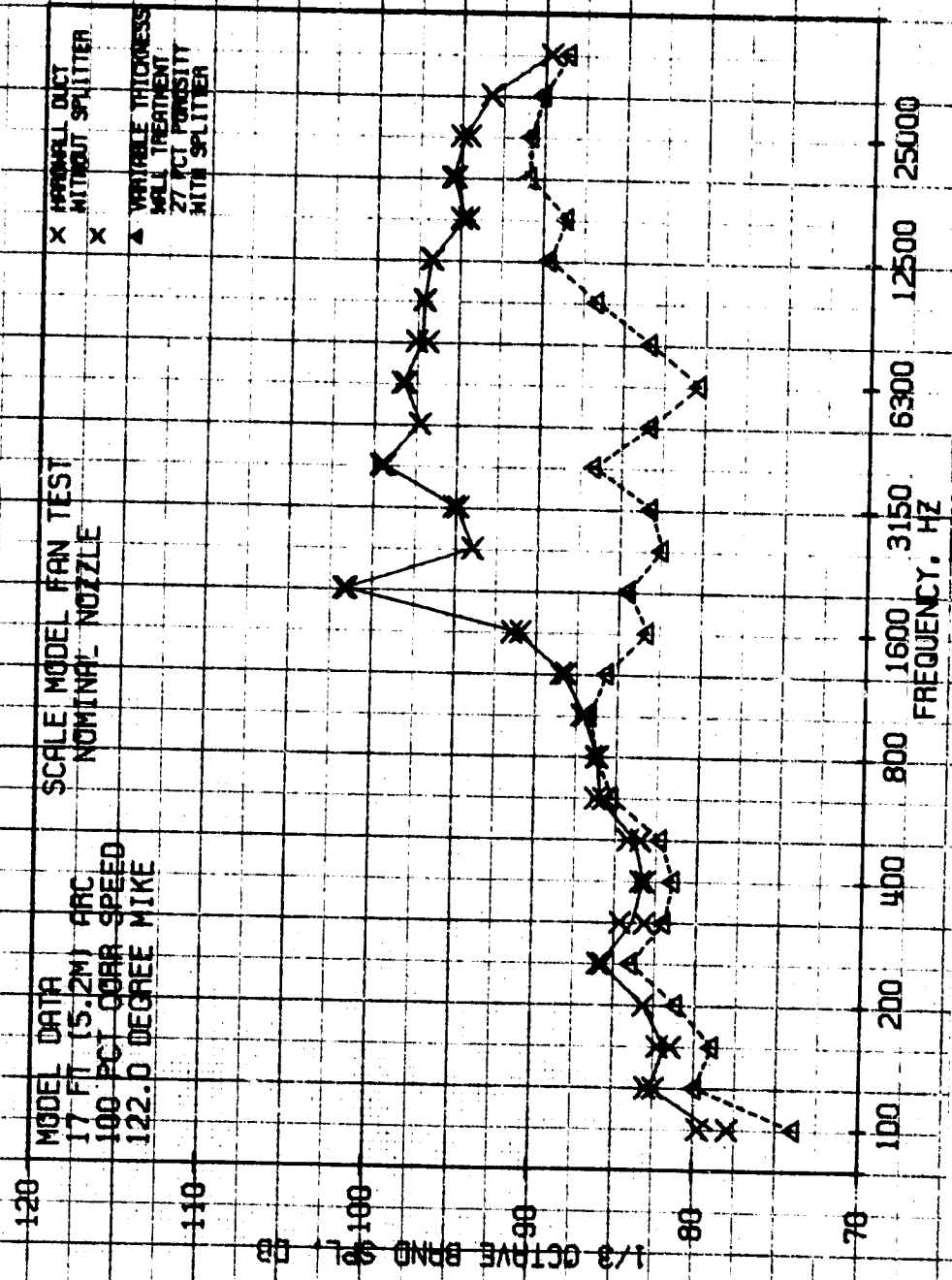
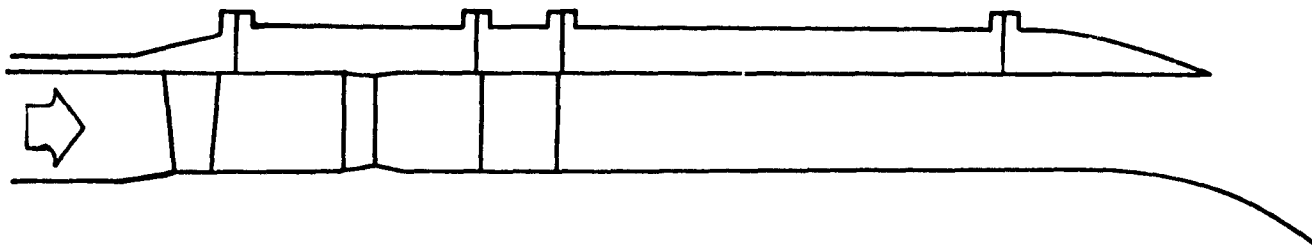
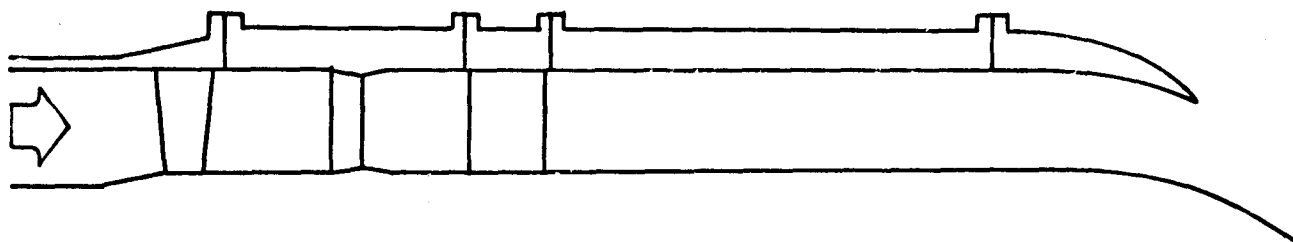


FIGURE 123

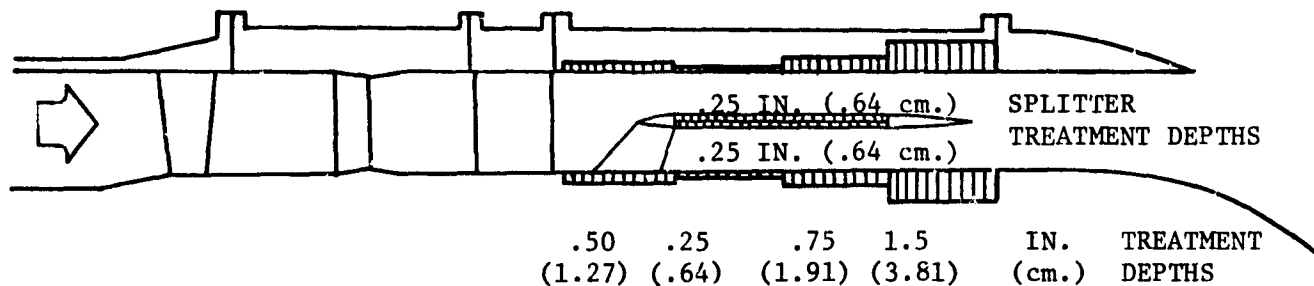
CONFIGURATION 23, HARDWALL, OPEN NOZZLE



CONFIGURATION 18, HARDWALL, NOMINAL NOZZLE



CONFIGURATION 10, POROSITY = 27%, OPEN NOZZLE W/SPLITTER



CONFIGURATION 9, POROSITY = 27%, NOMINAL NOZZLE W/SPLITTER

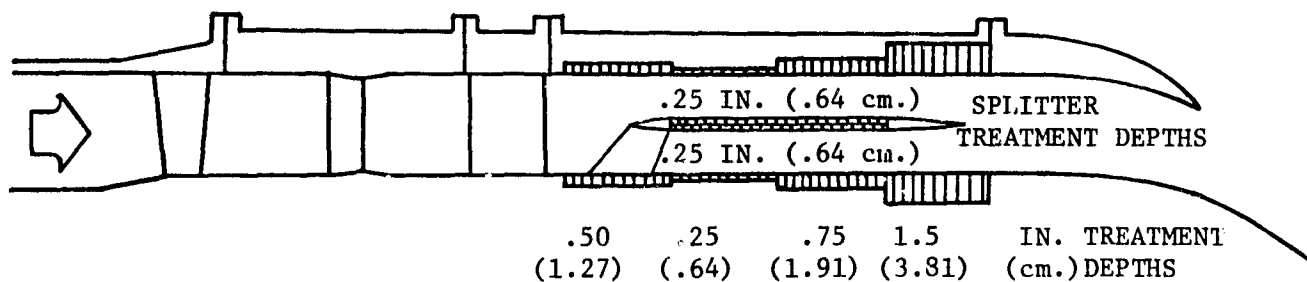


FIGURE 124. TREATMENT REGENERATED FLOW NOISE CONFIGURATIONS

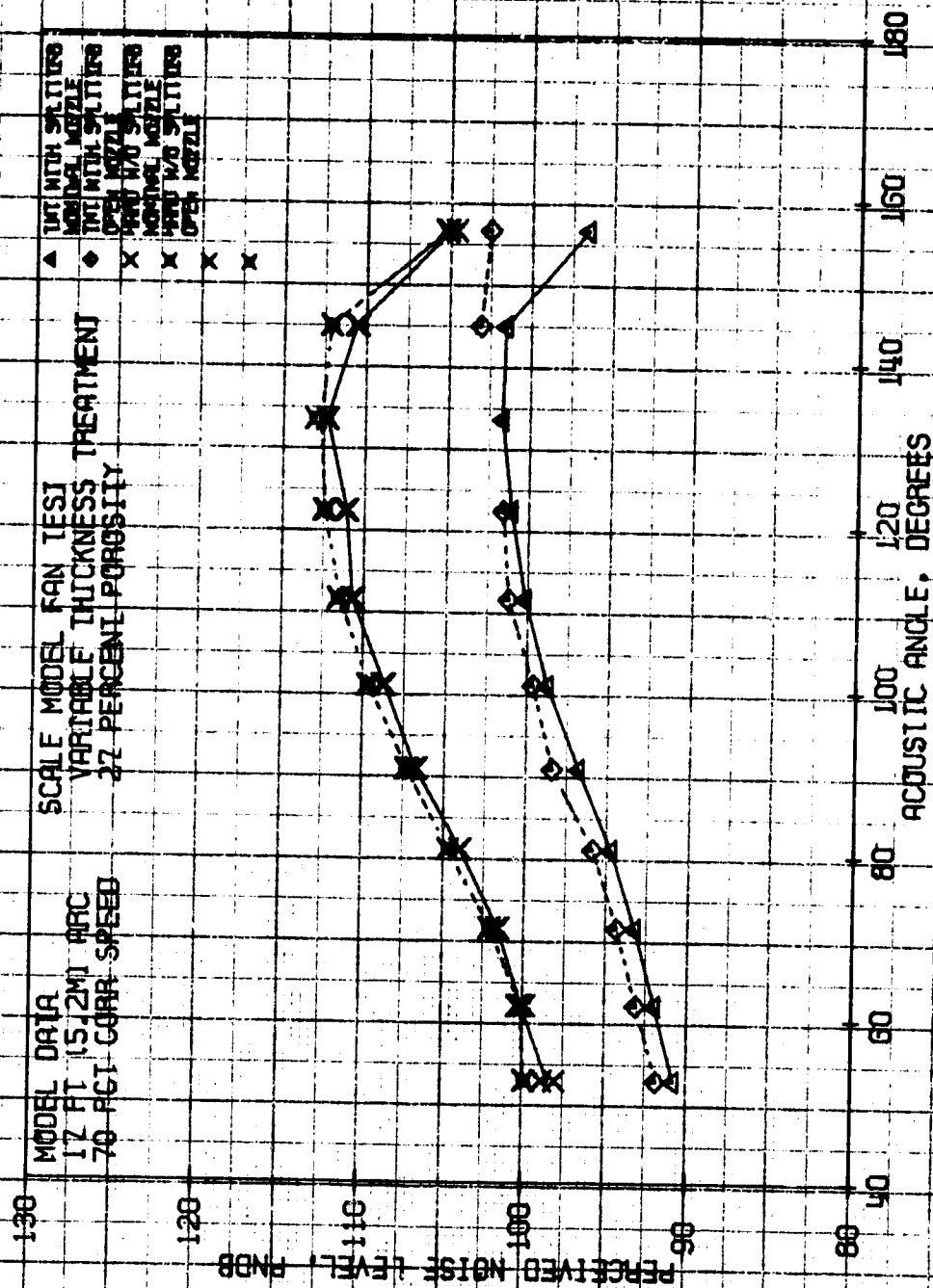


FIGURE 125

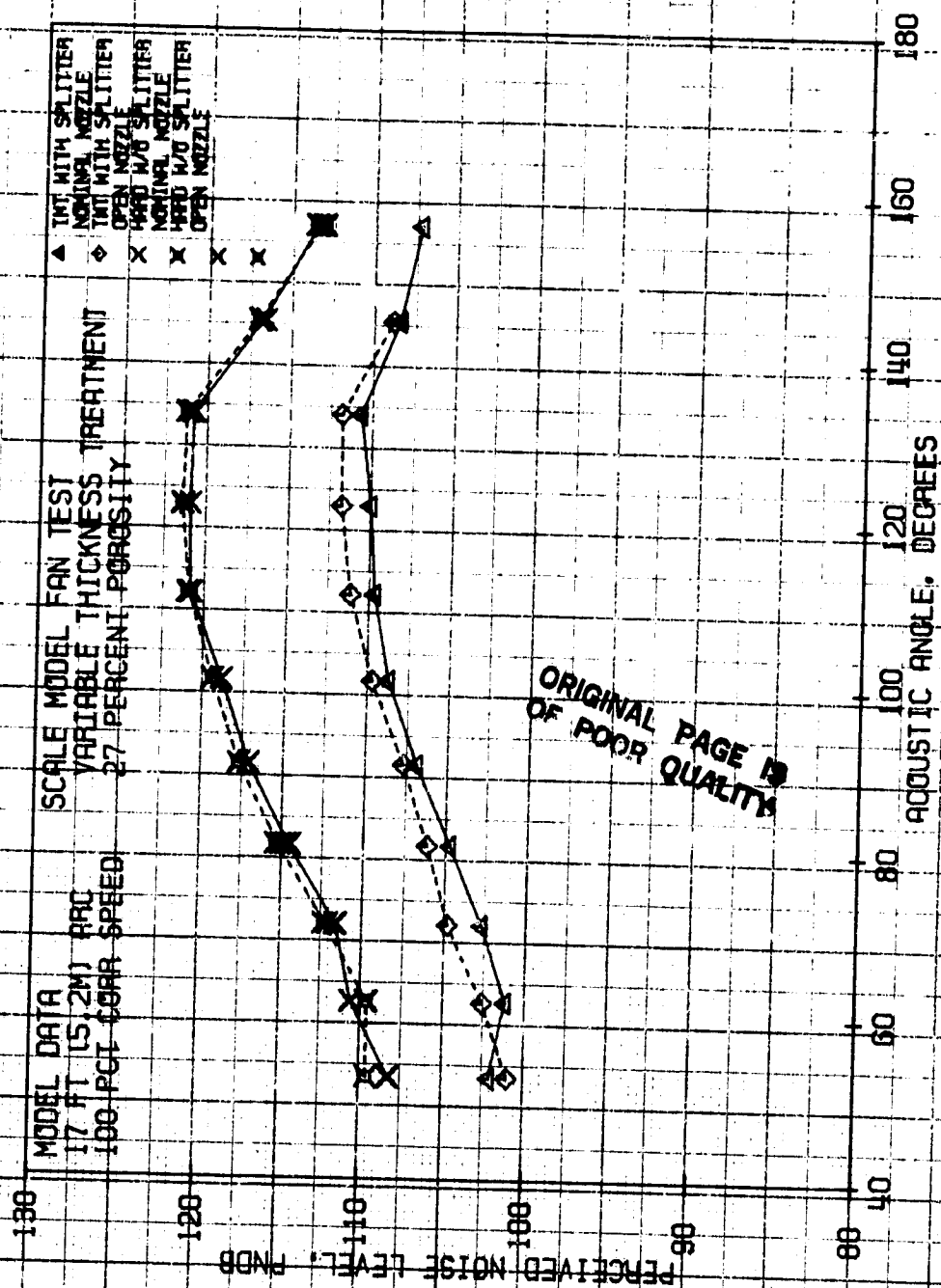


FIGURE 126

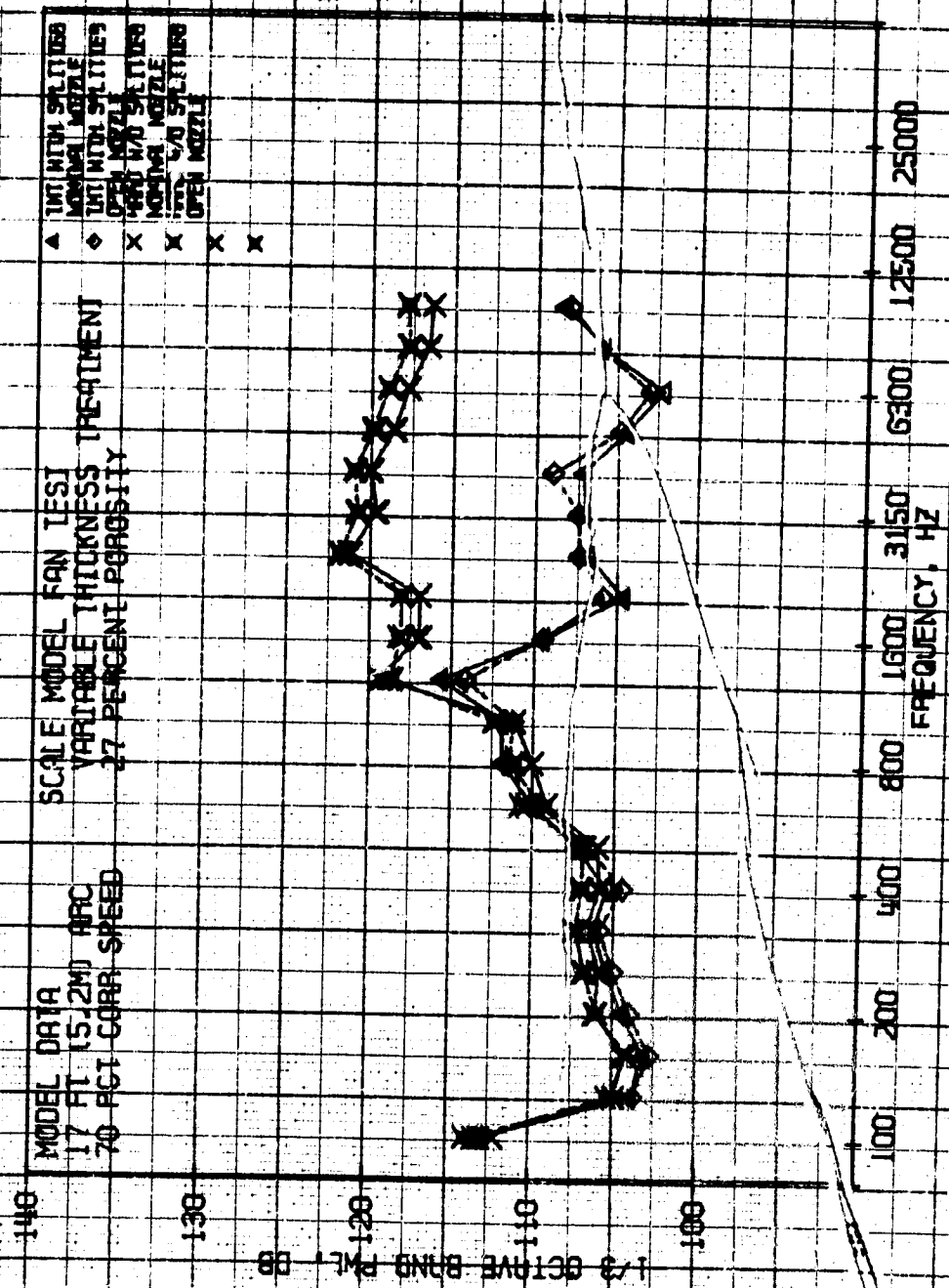


FIGURE 127

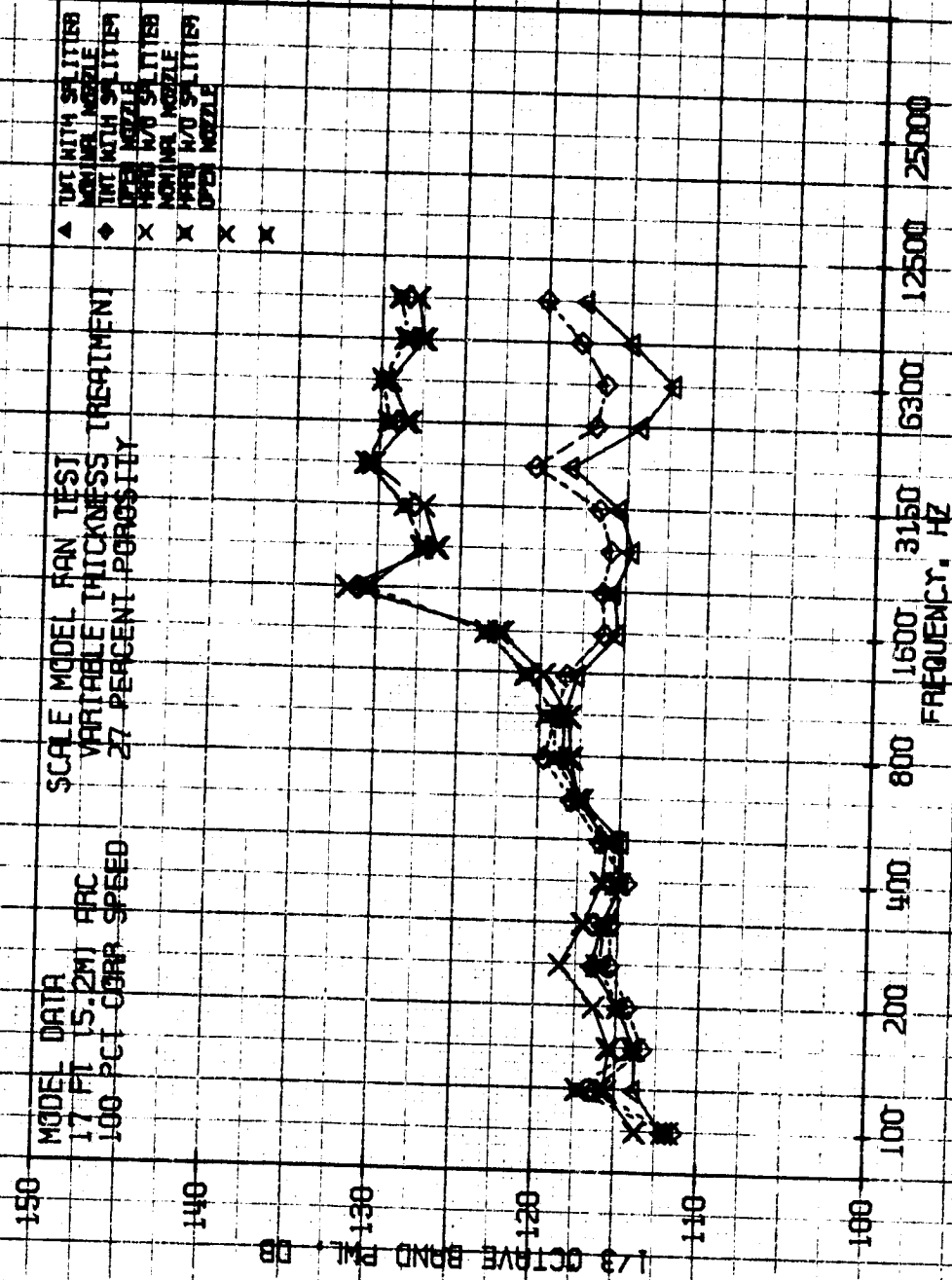


FIGURE 128

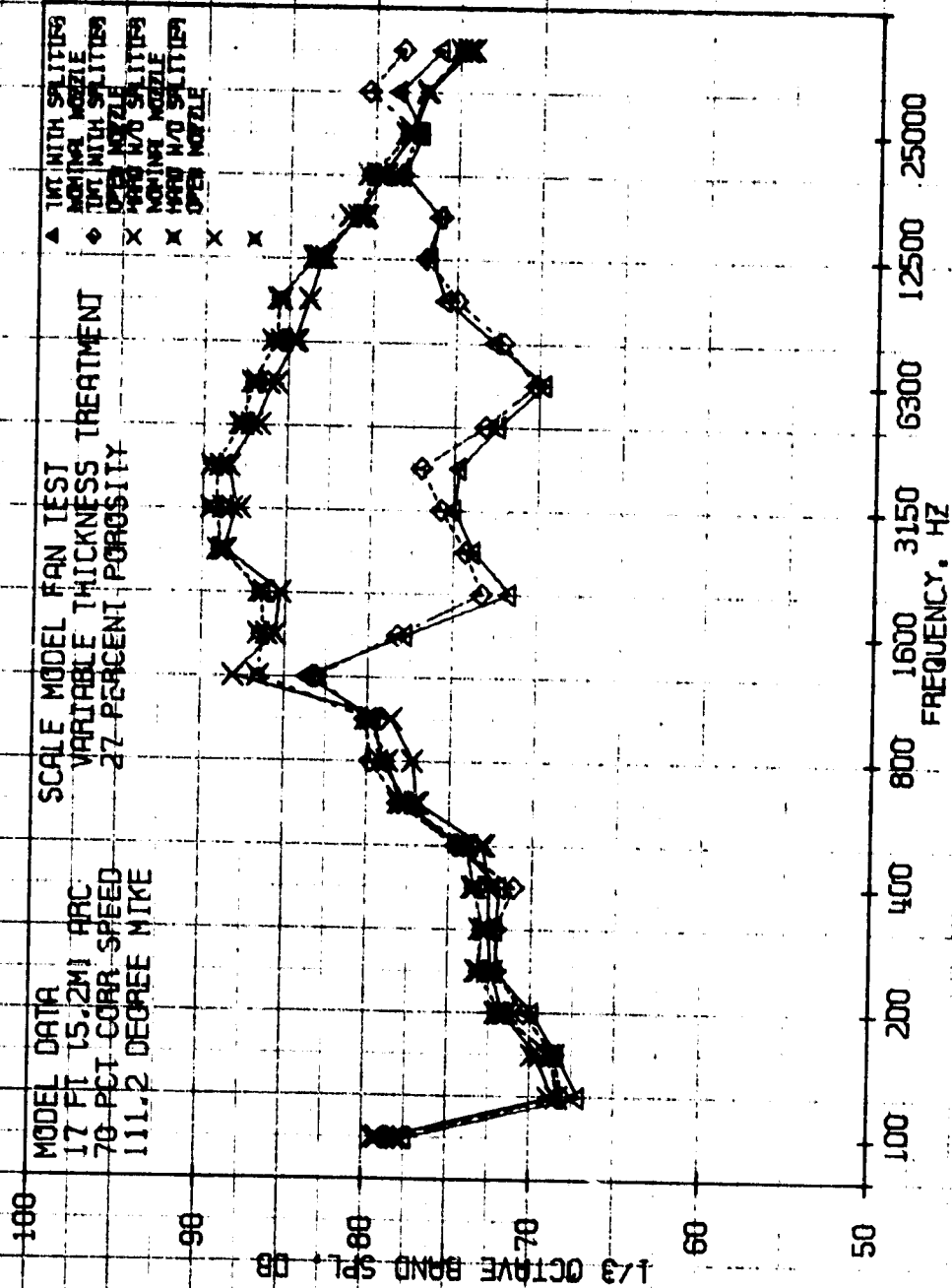


FIGURE 129



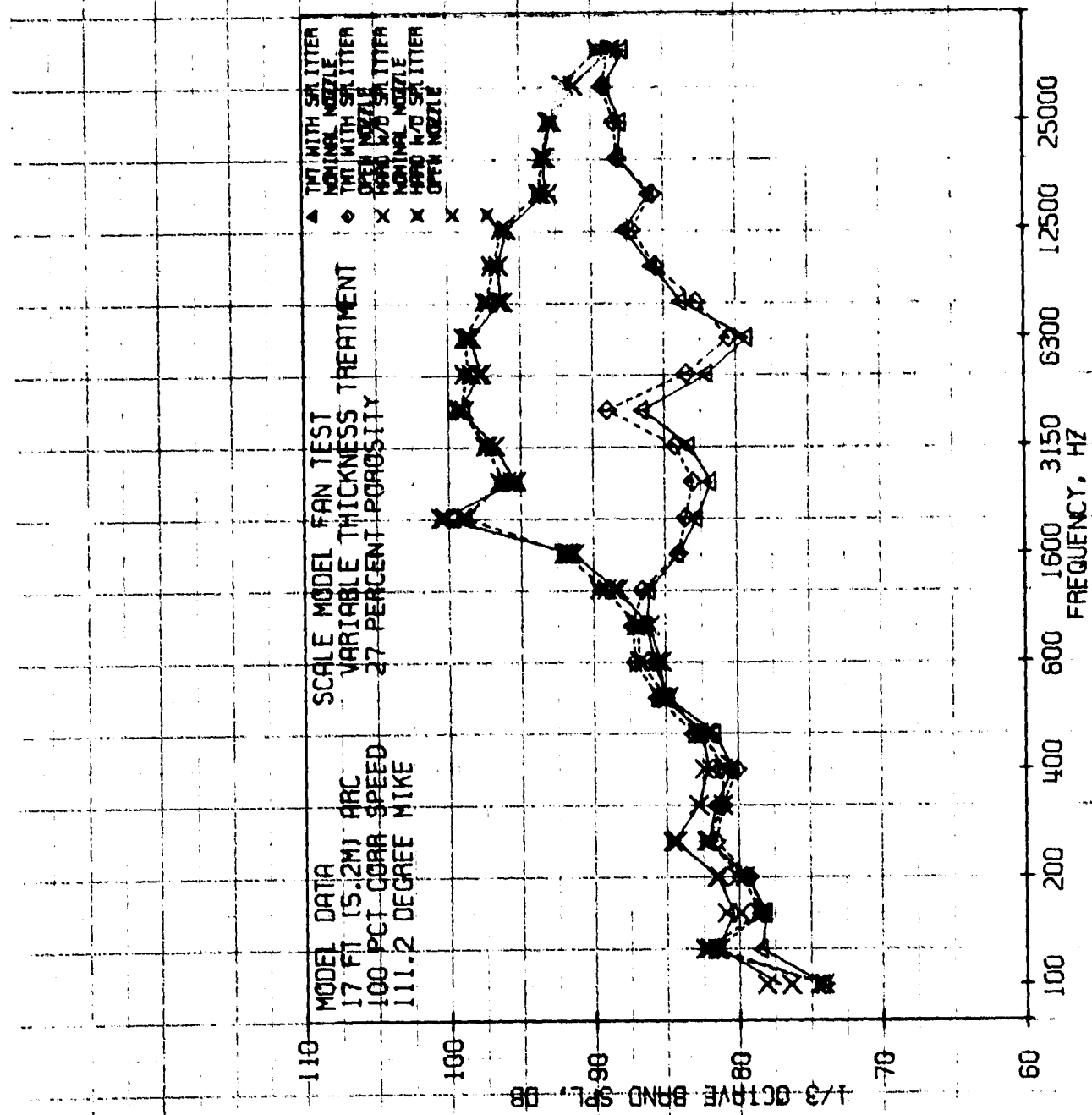


FIGURE 130

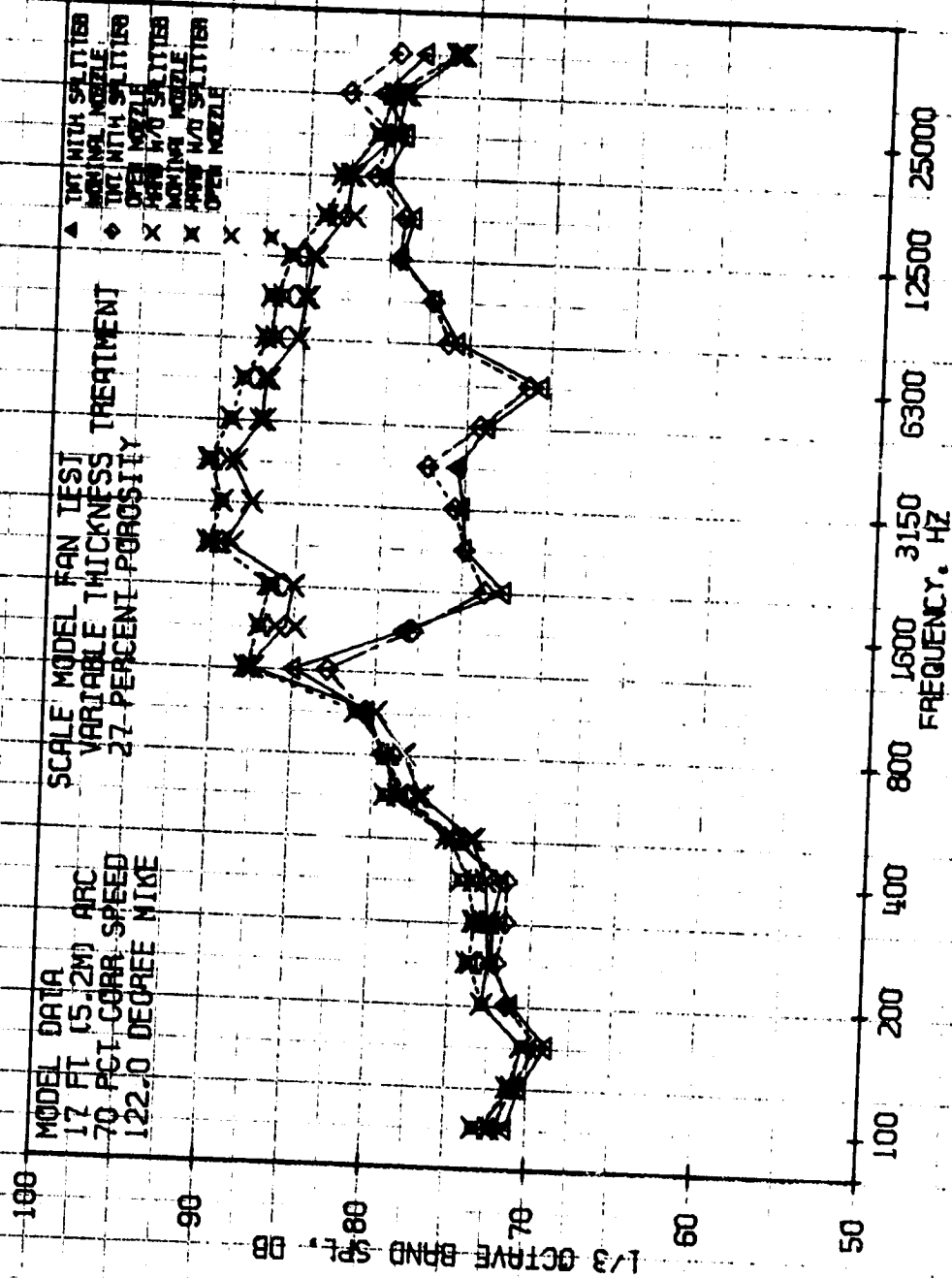


FIGURE 131

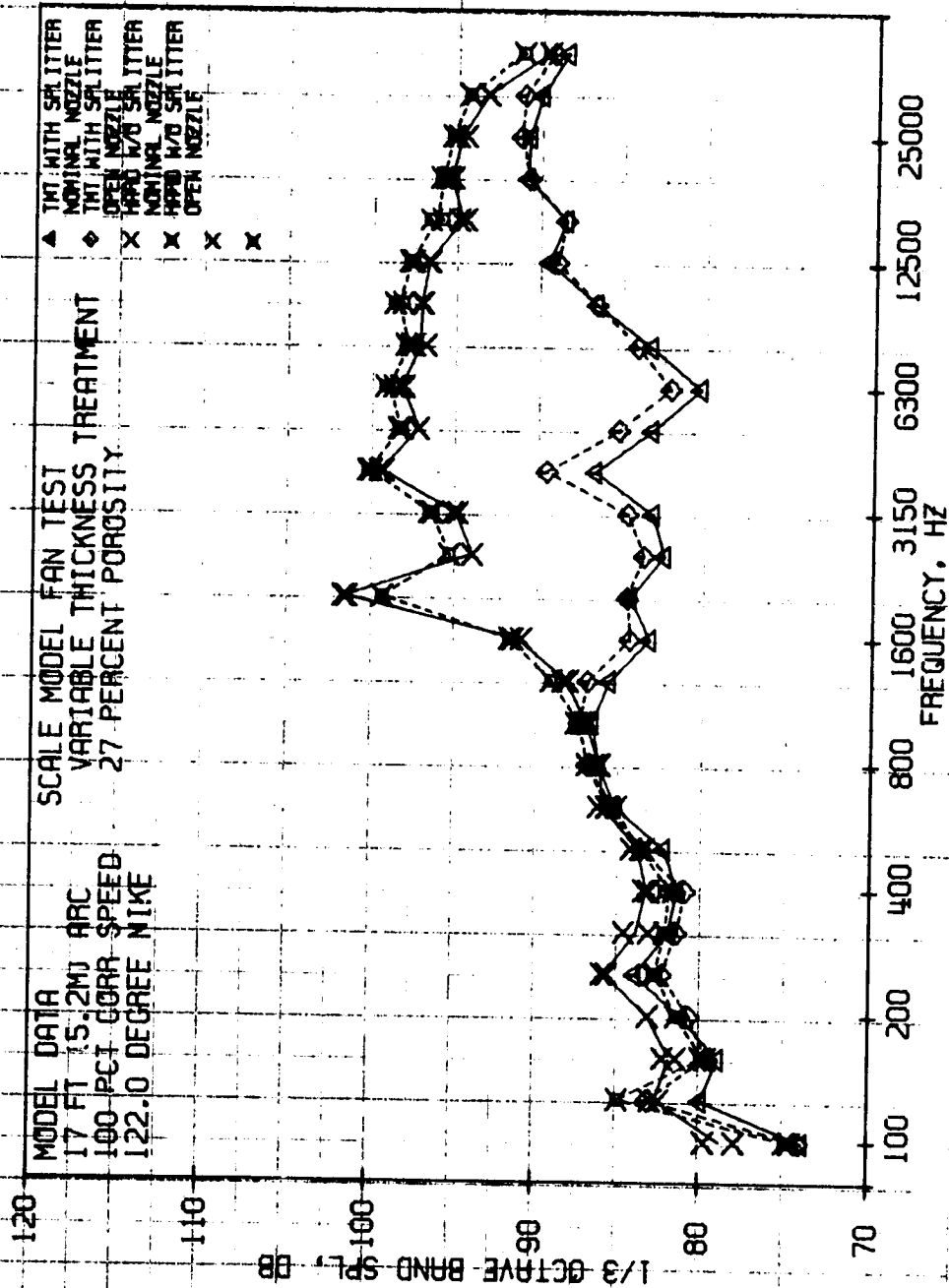
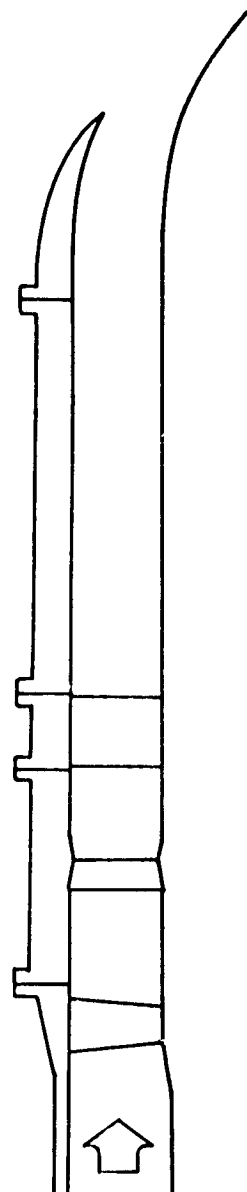


FIGURE 132

CONFIGURATION 18, HARDWALL



CONFIGURATION 17, 27 PERCENT POROSITY

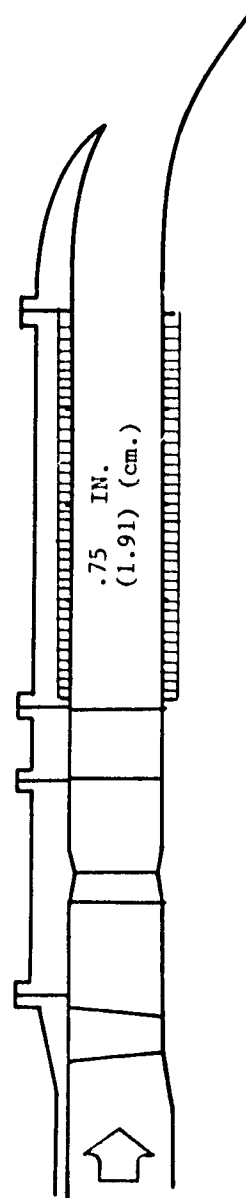


FIGURE 133 27 PERCENT POROSITY, CONSTANT THICKNESS CONFIGURATION

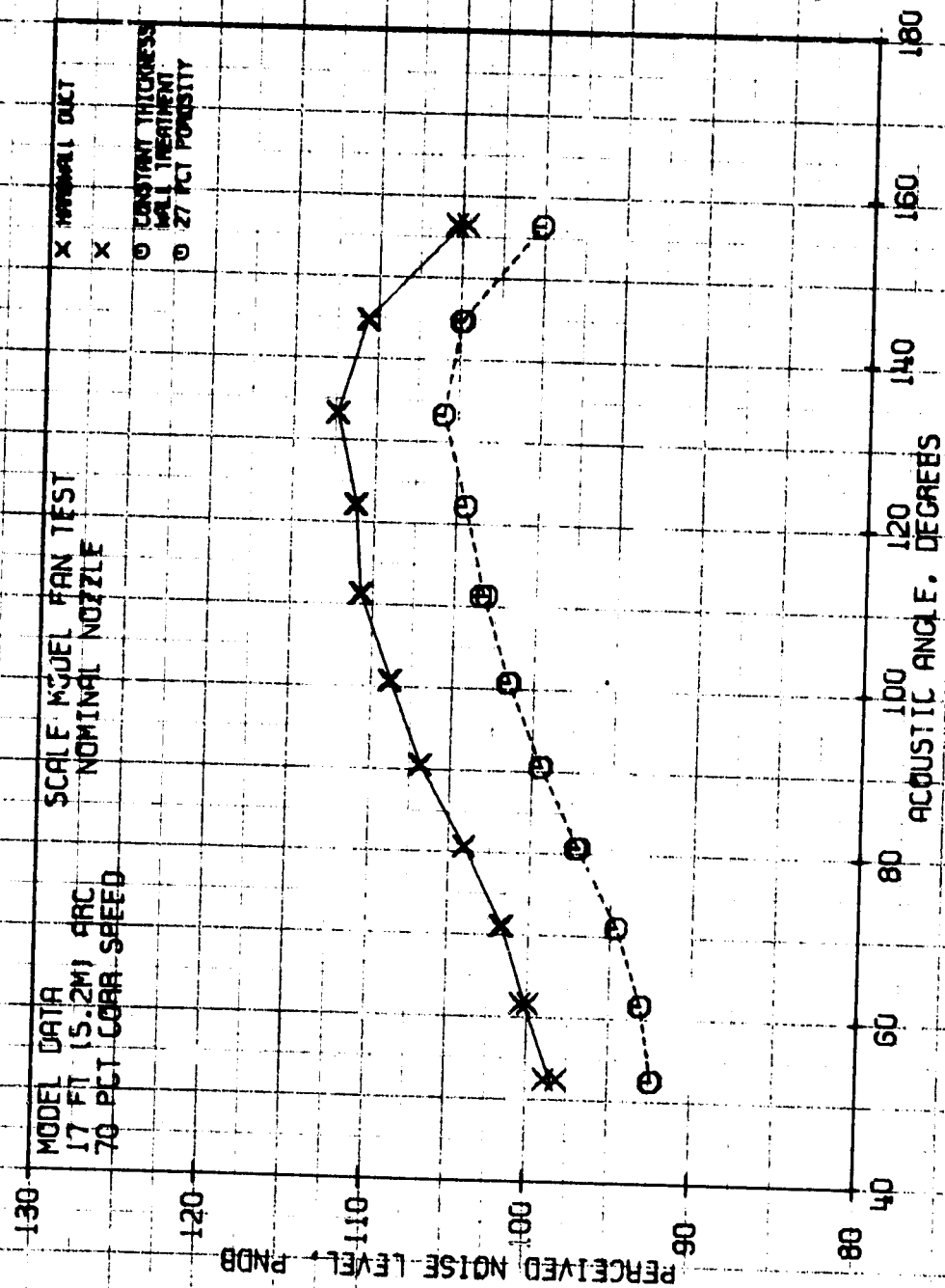


FIGURE 134

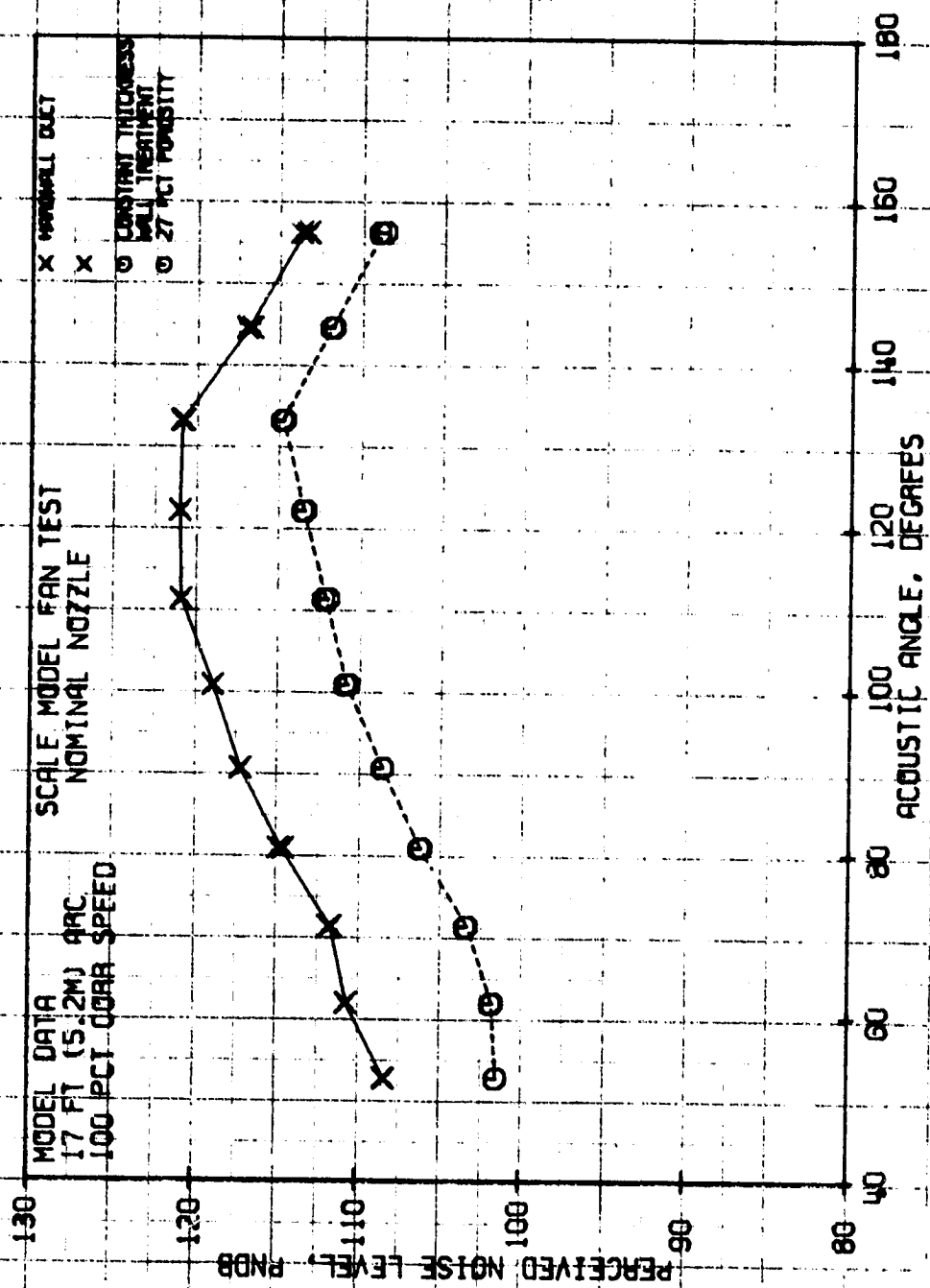


FIGURE 135

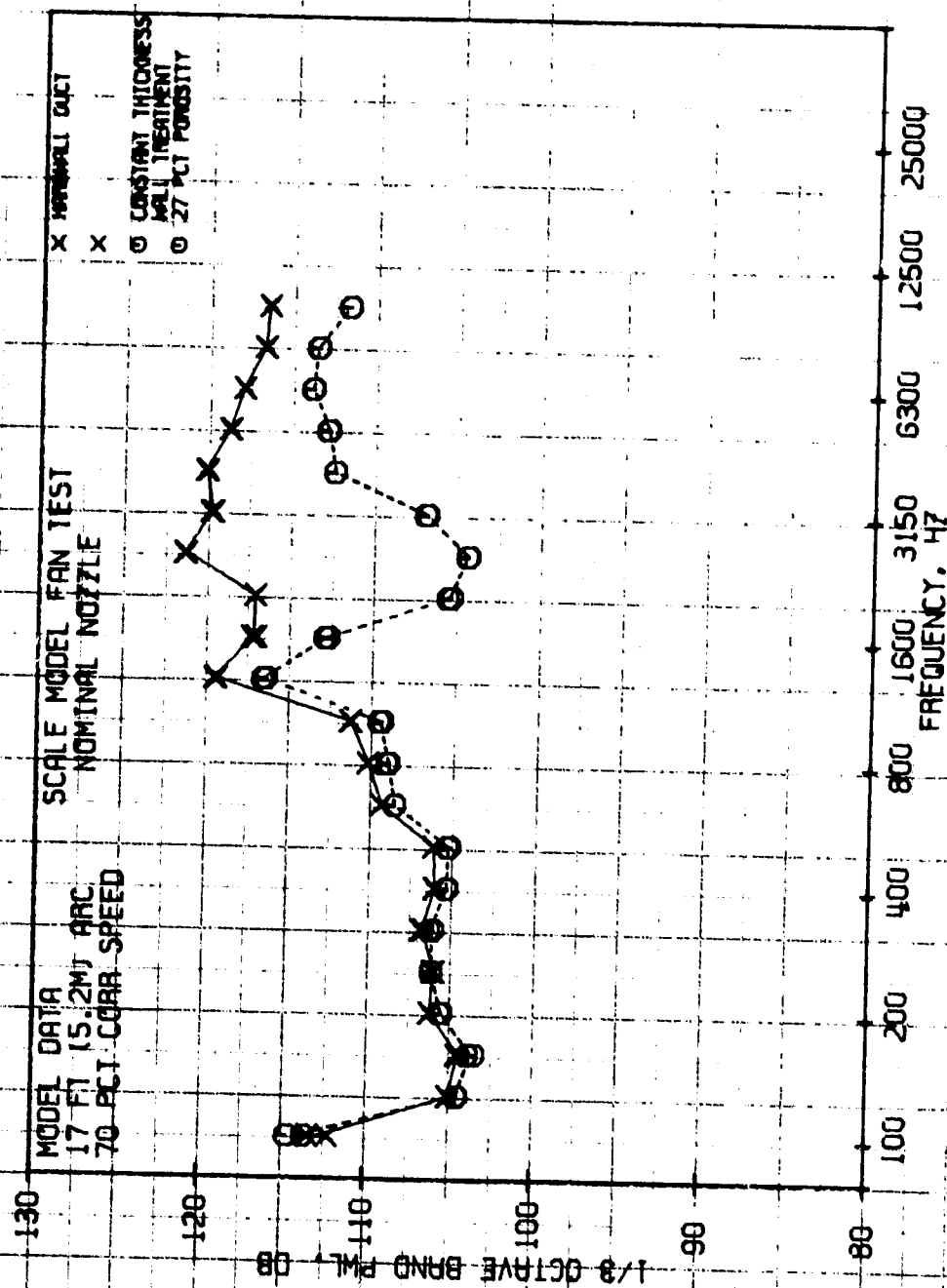


FIGURE 136

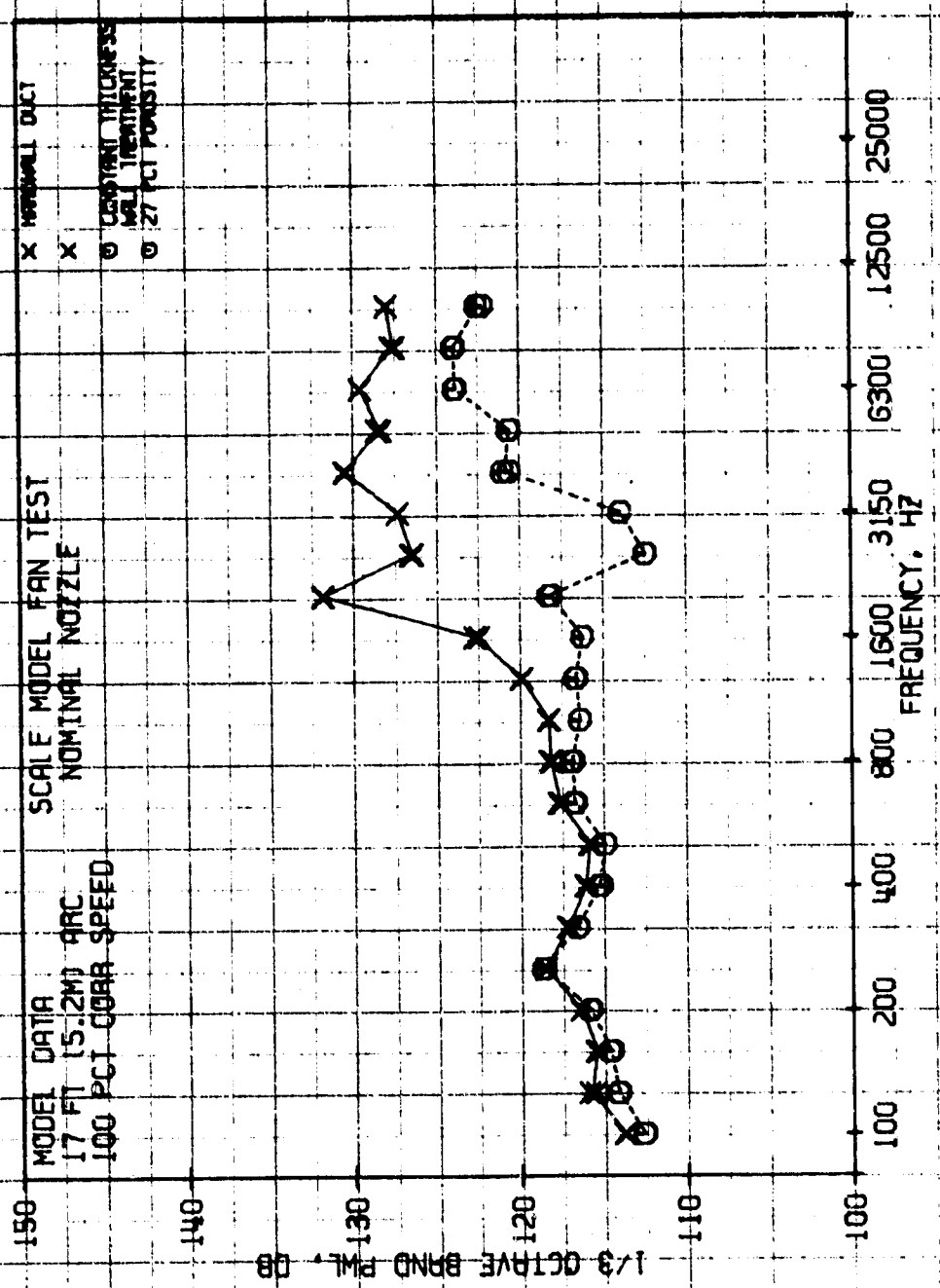


FIGURE 137



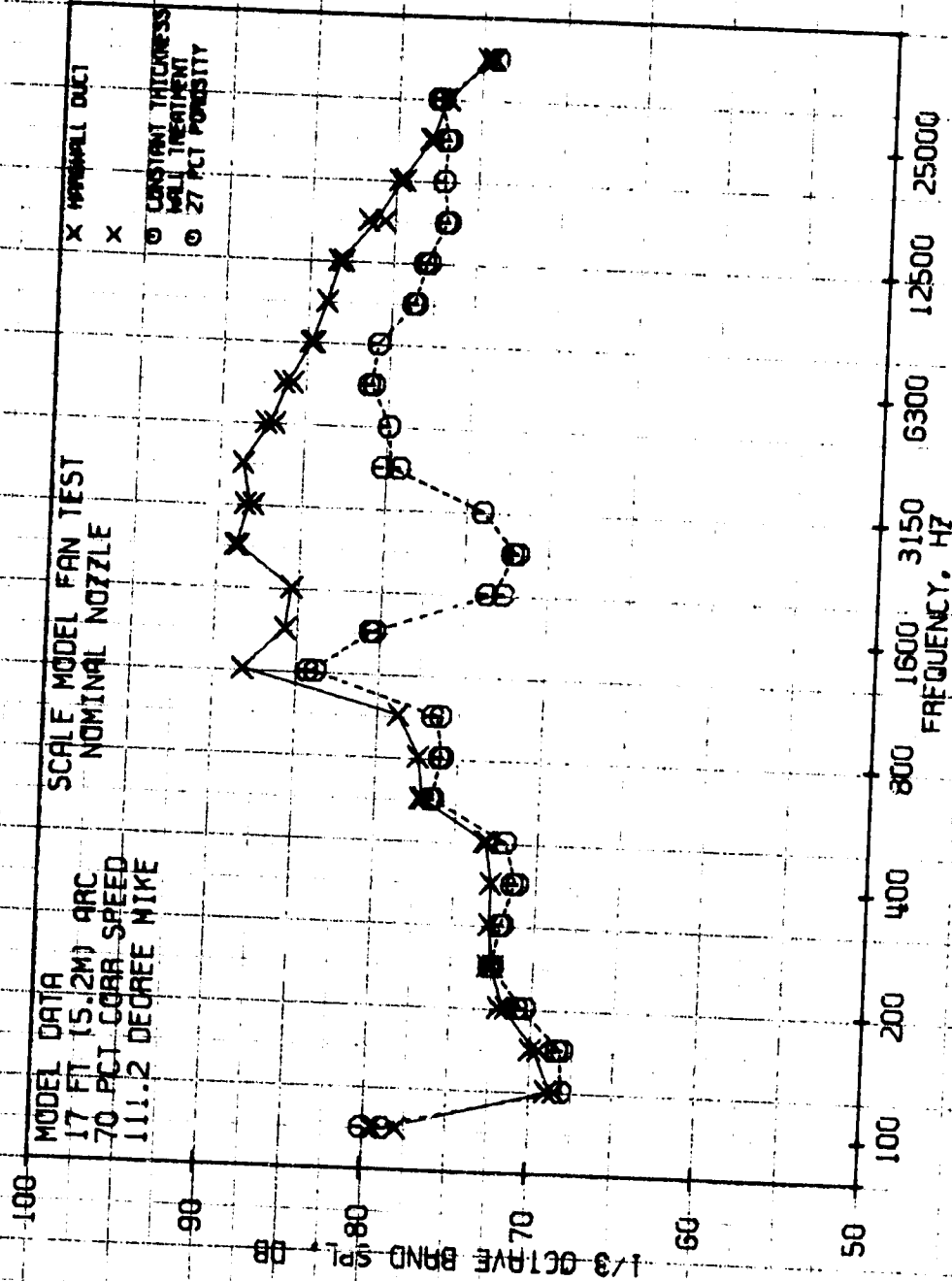


FIGURE 138

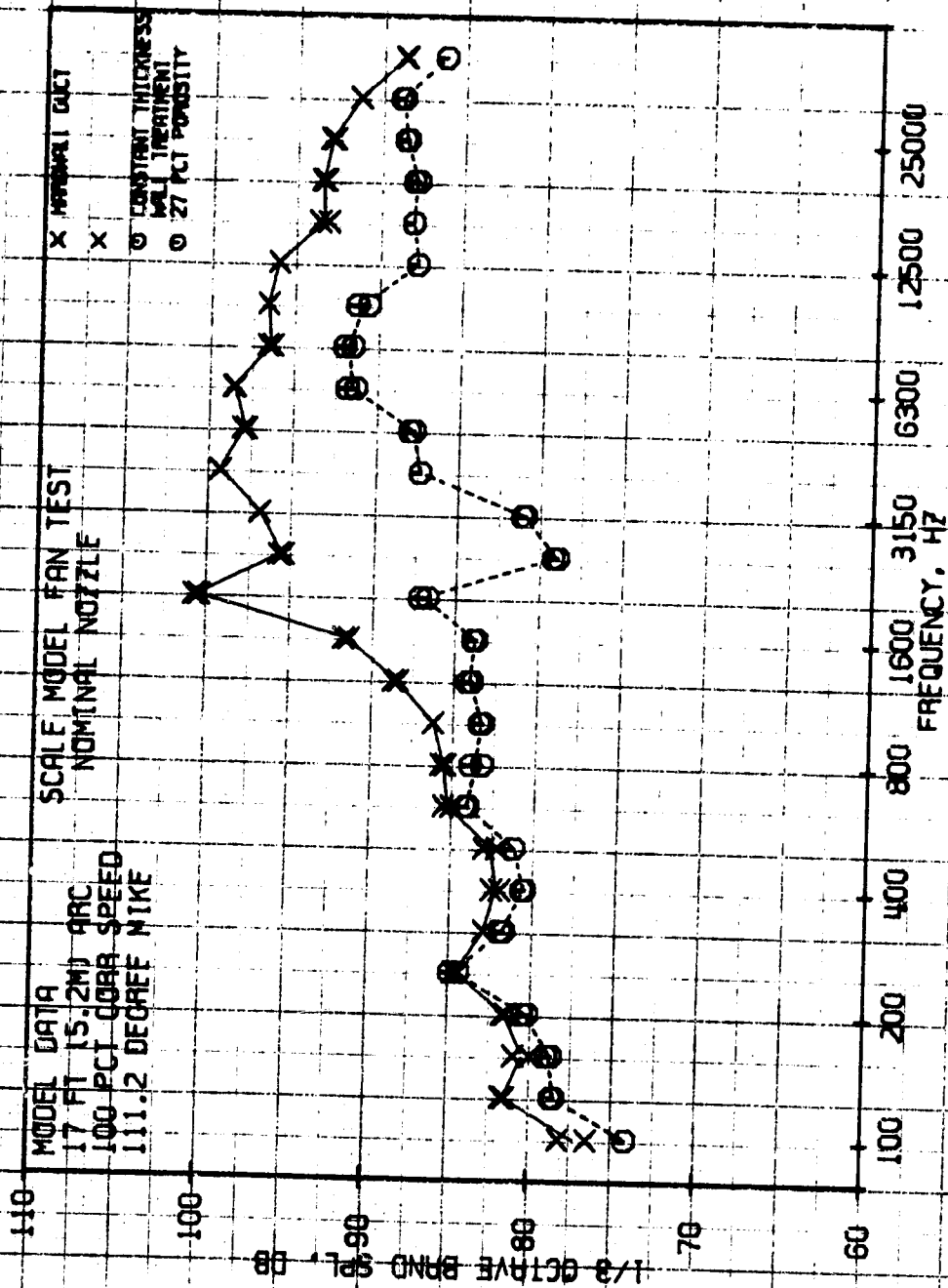
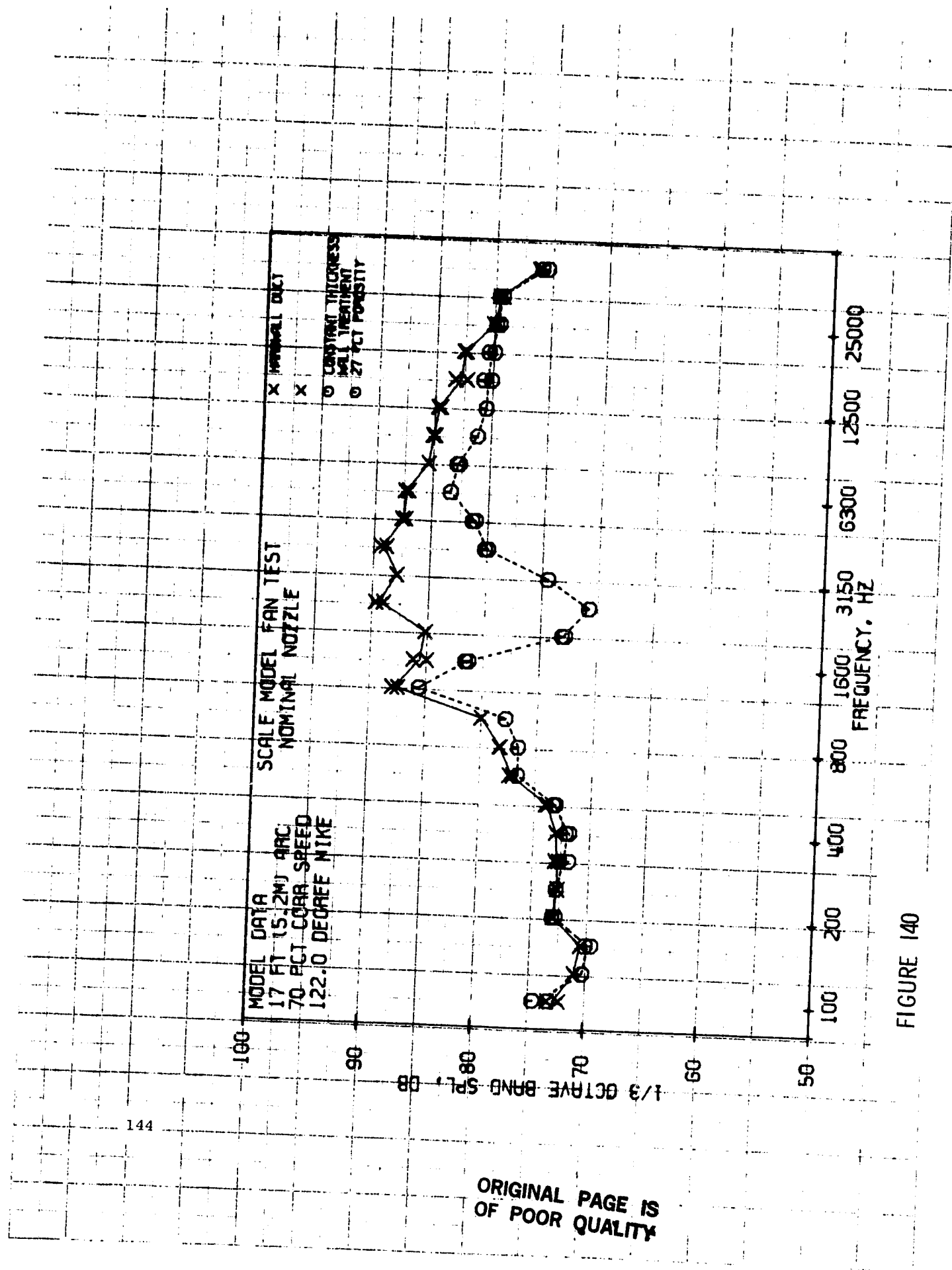


FIGURE 139



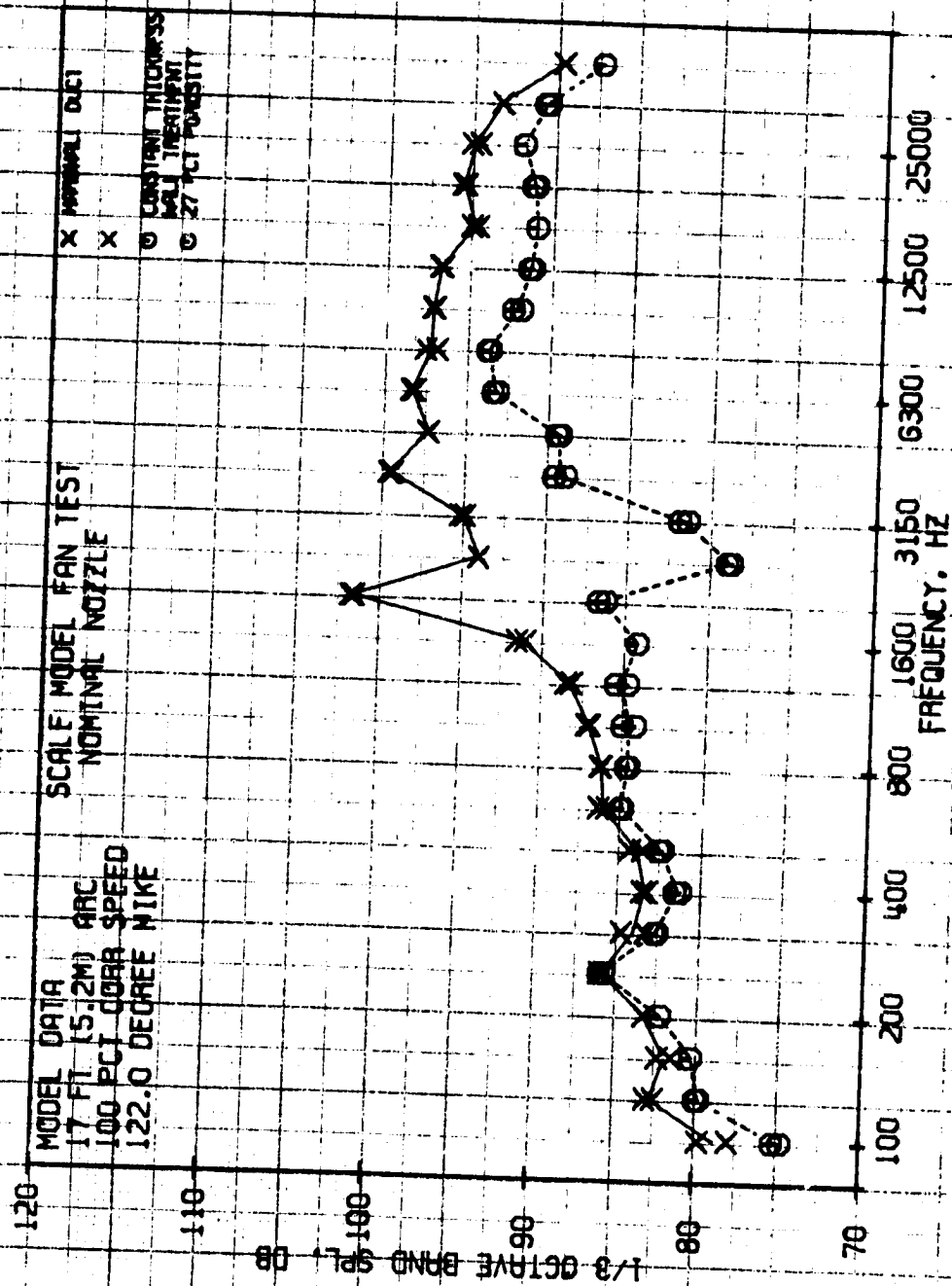
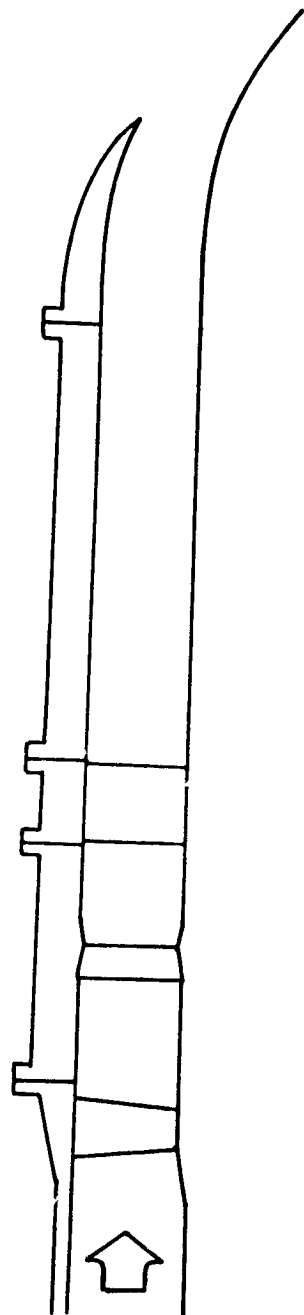


FIGURE 141

CONFIGURATION 18, HARDWALL , NOMINAL NOZZLE



CONFIGURATION 23, HARDWALL , OPEN NOZZLE

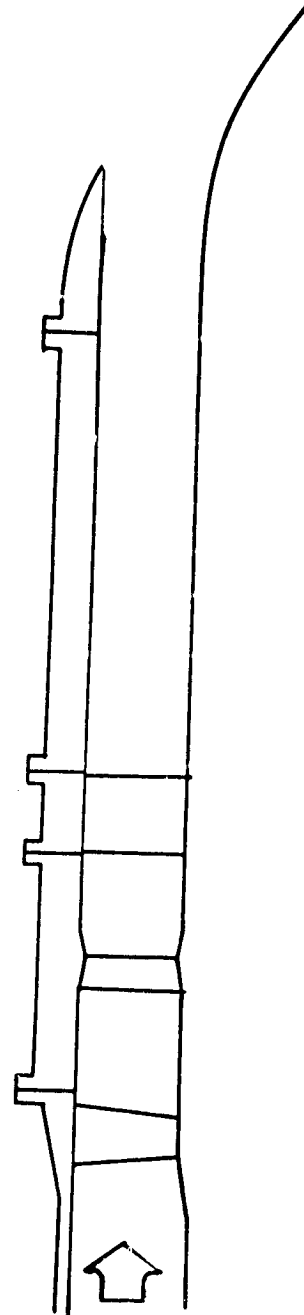


FIGURE 142 OPEN AND NOMINAL HARDWALL CONFIGURATIONS

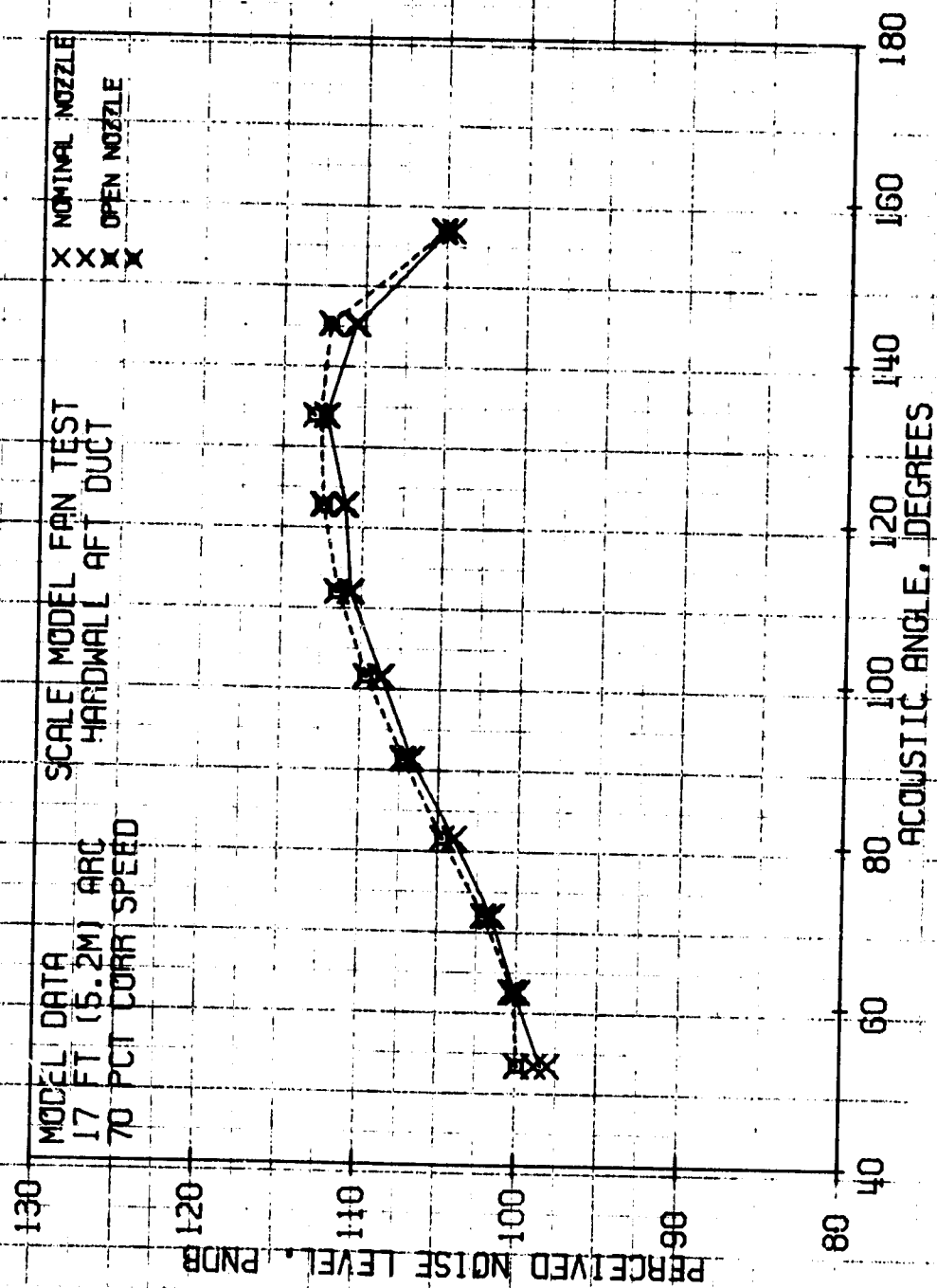


FIGURE 143

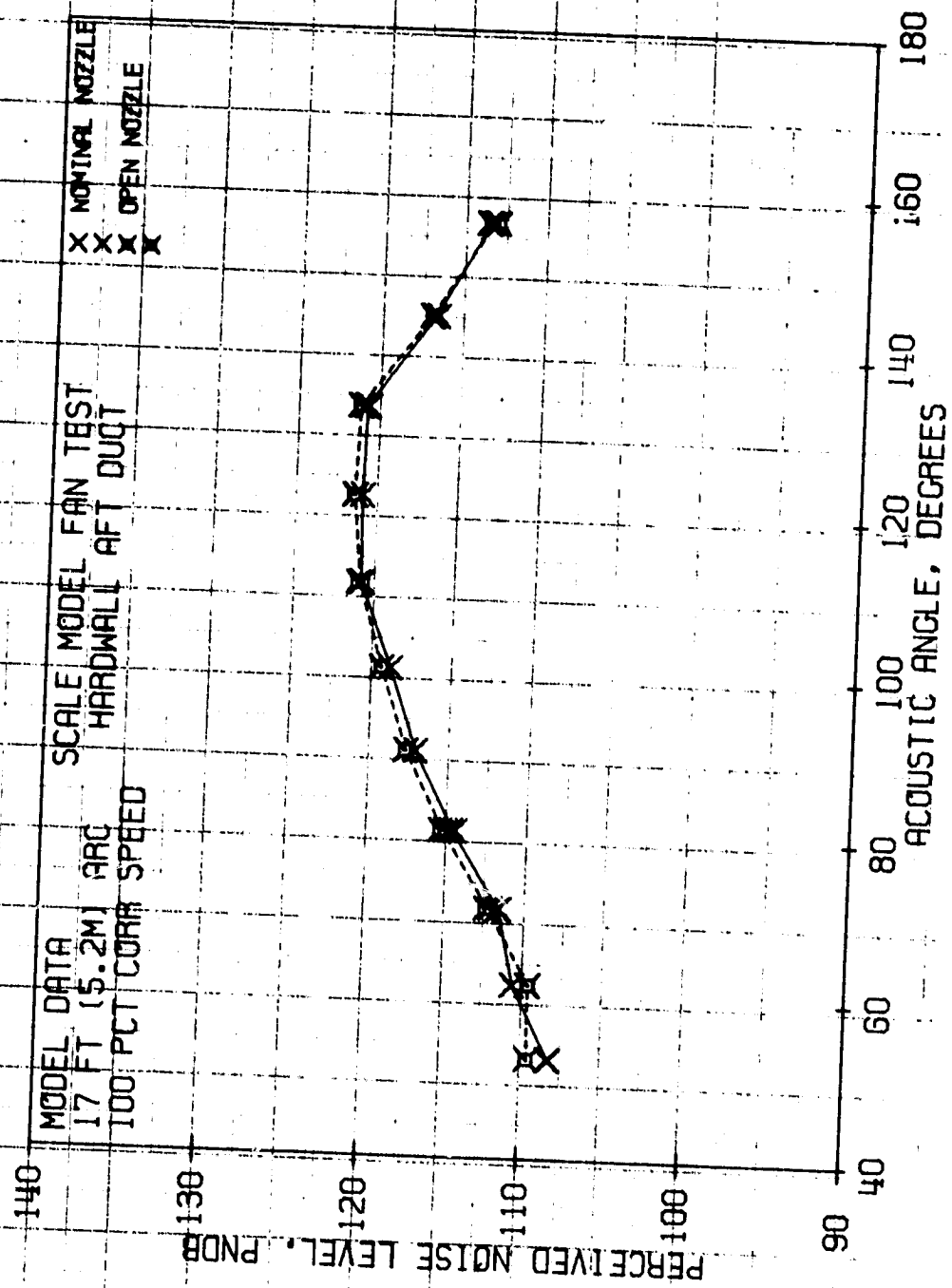


FIGURE 144

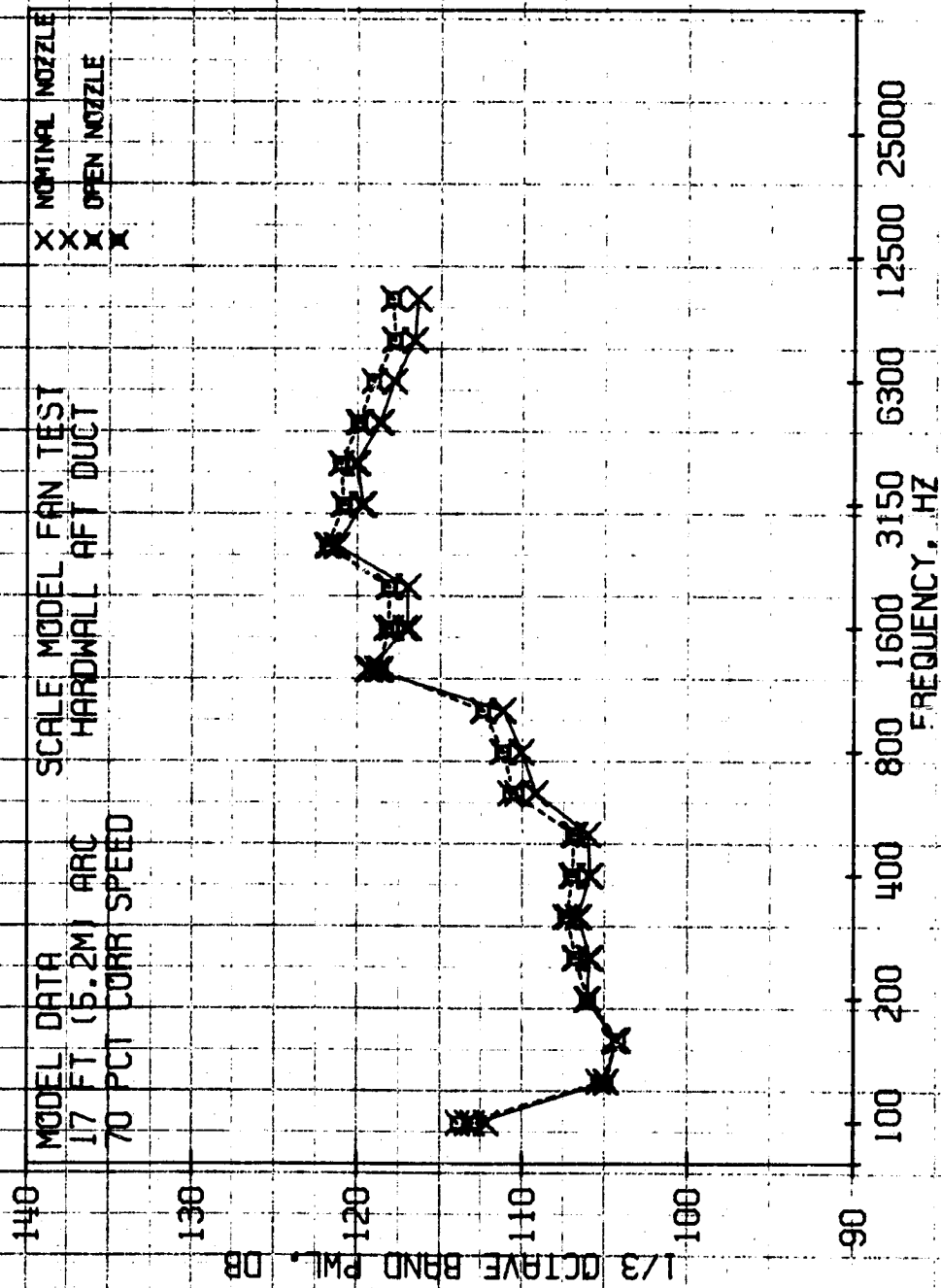


FIGURE 145



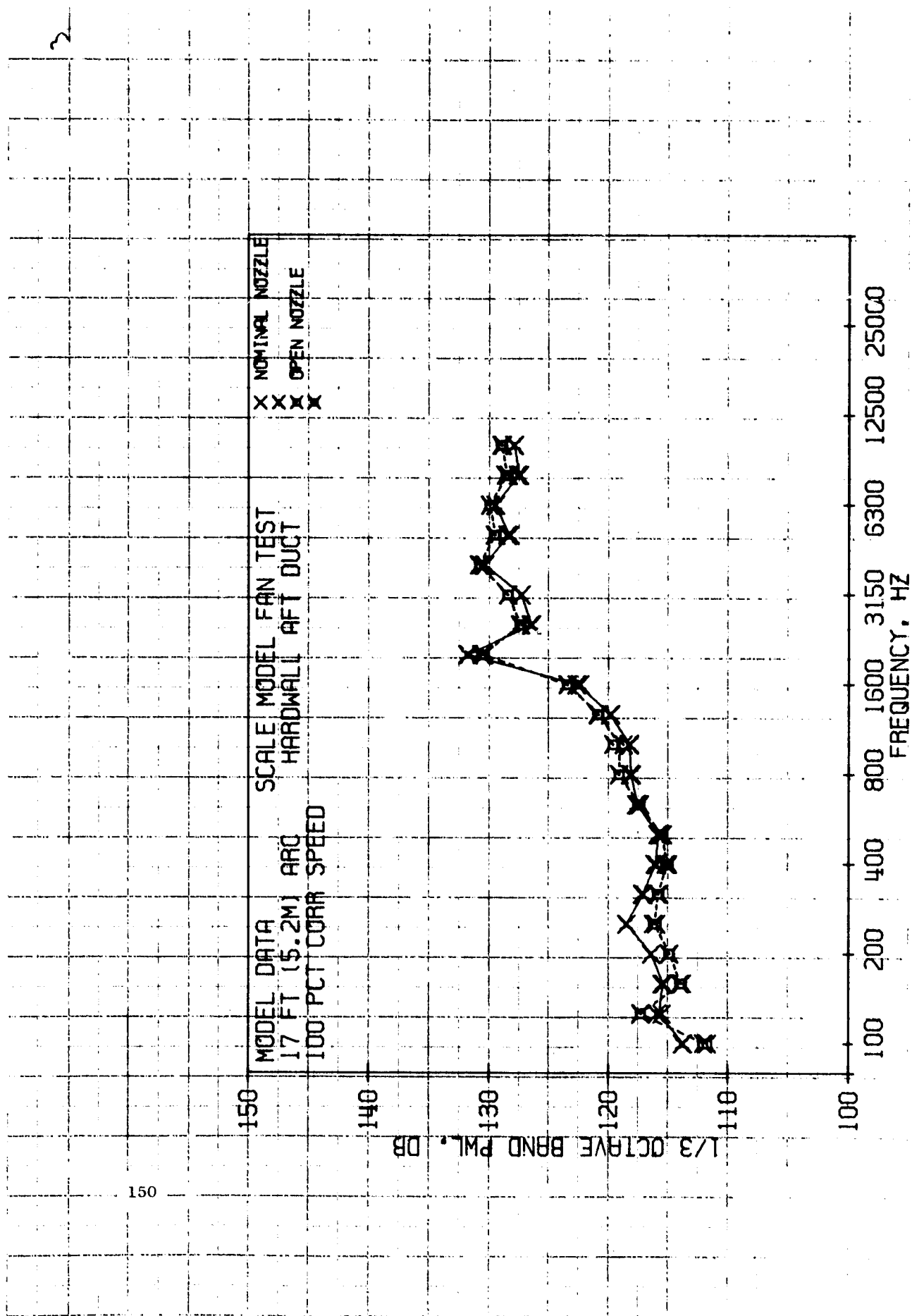


FIGURE 146

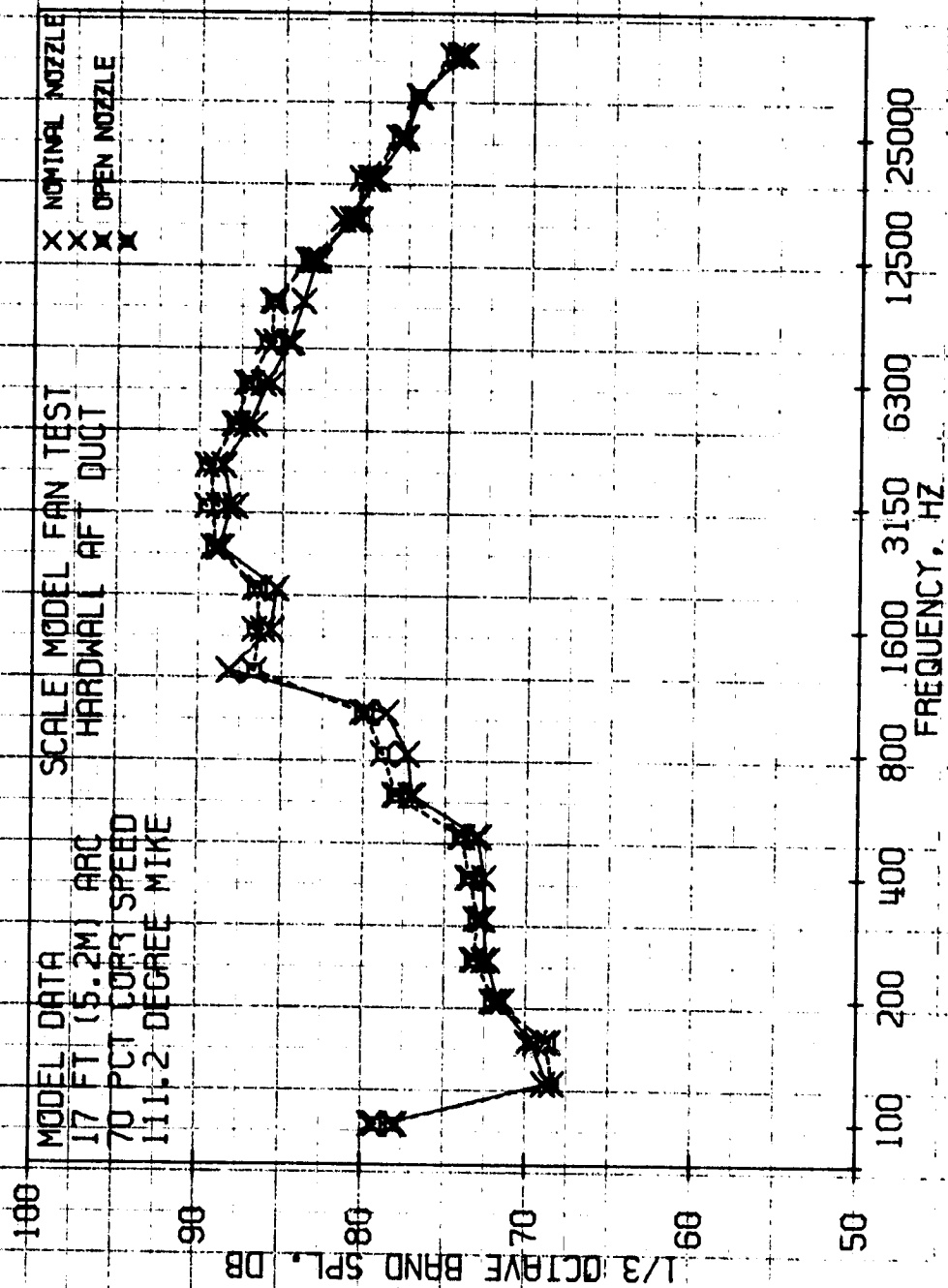


FIGURE 147

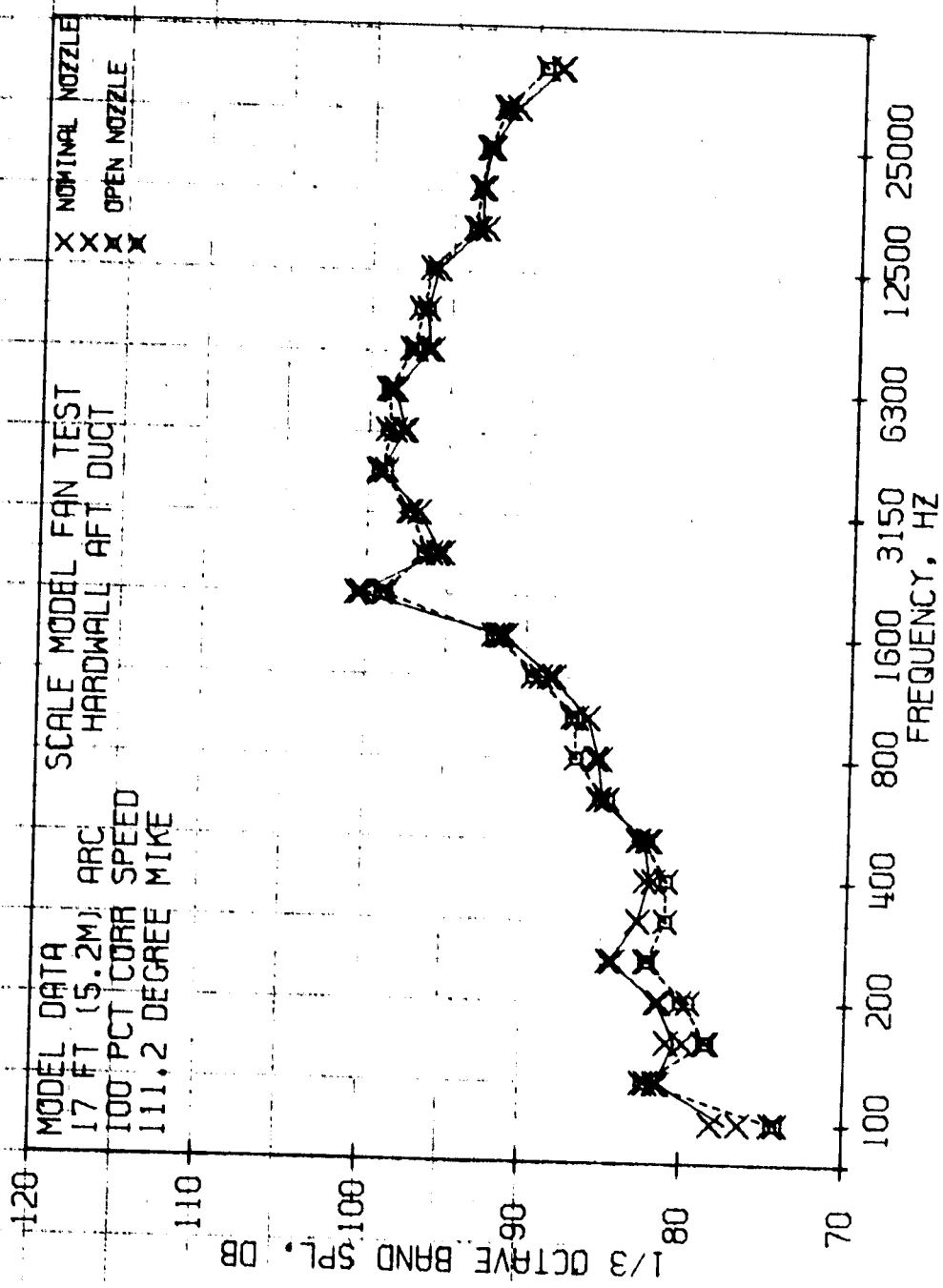


FIGURE 148

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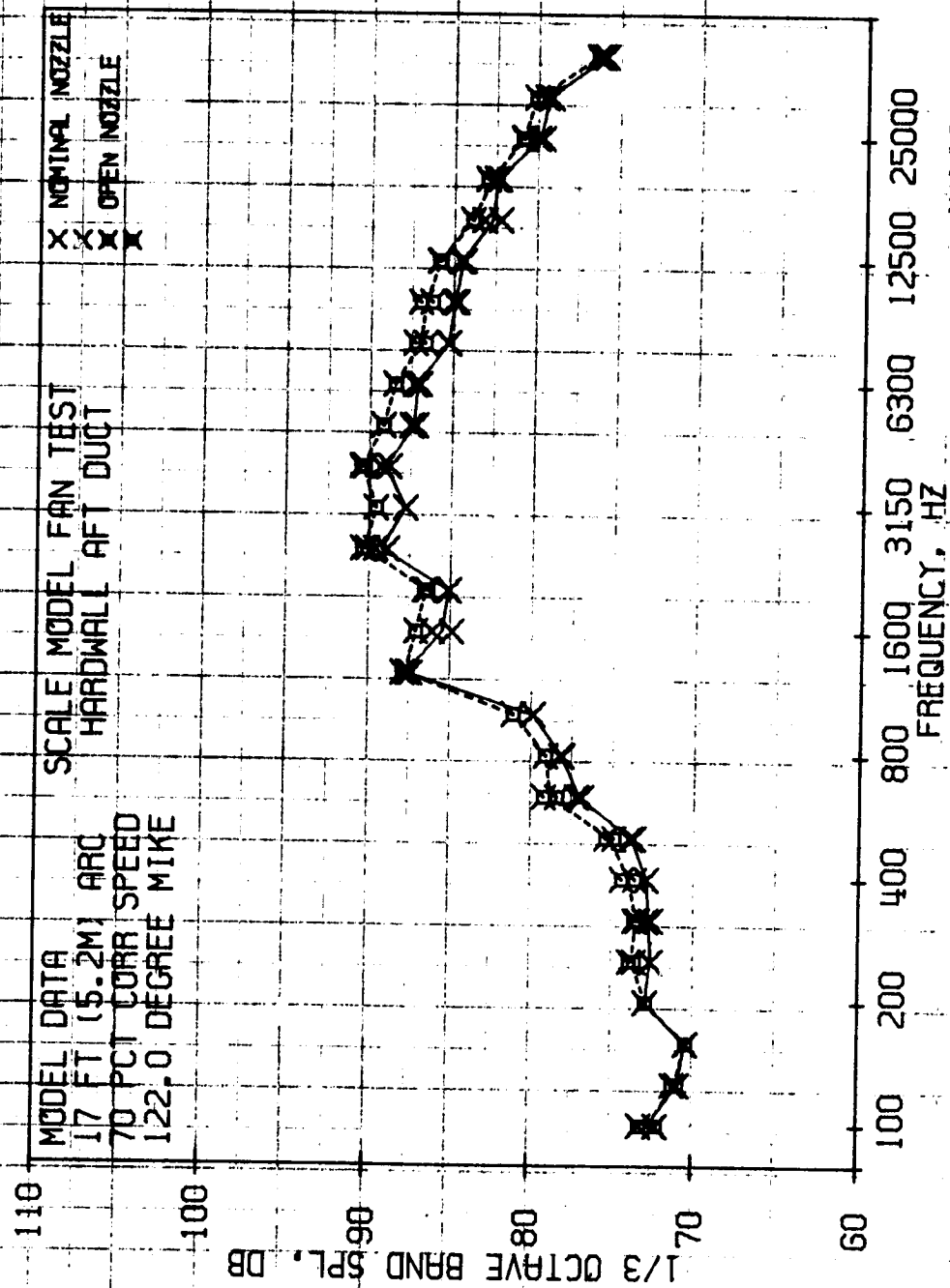


FIGURE 149

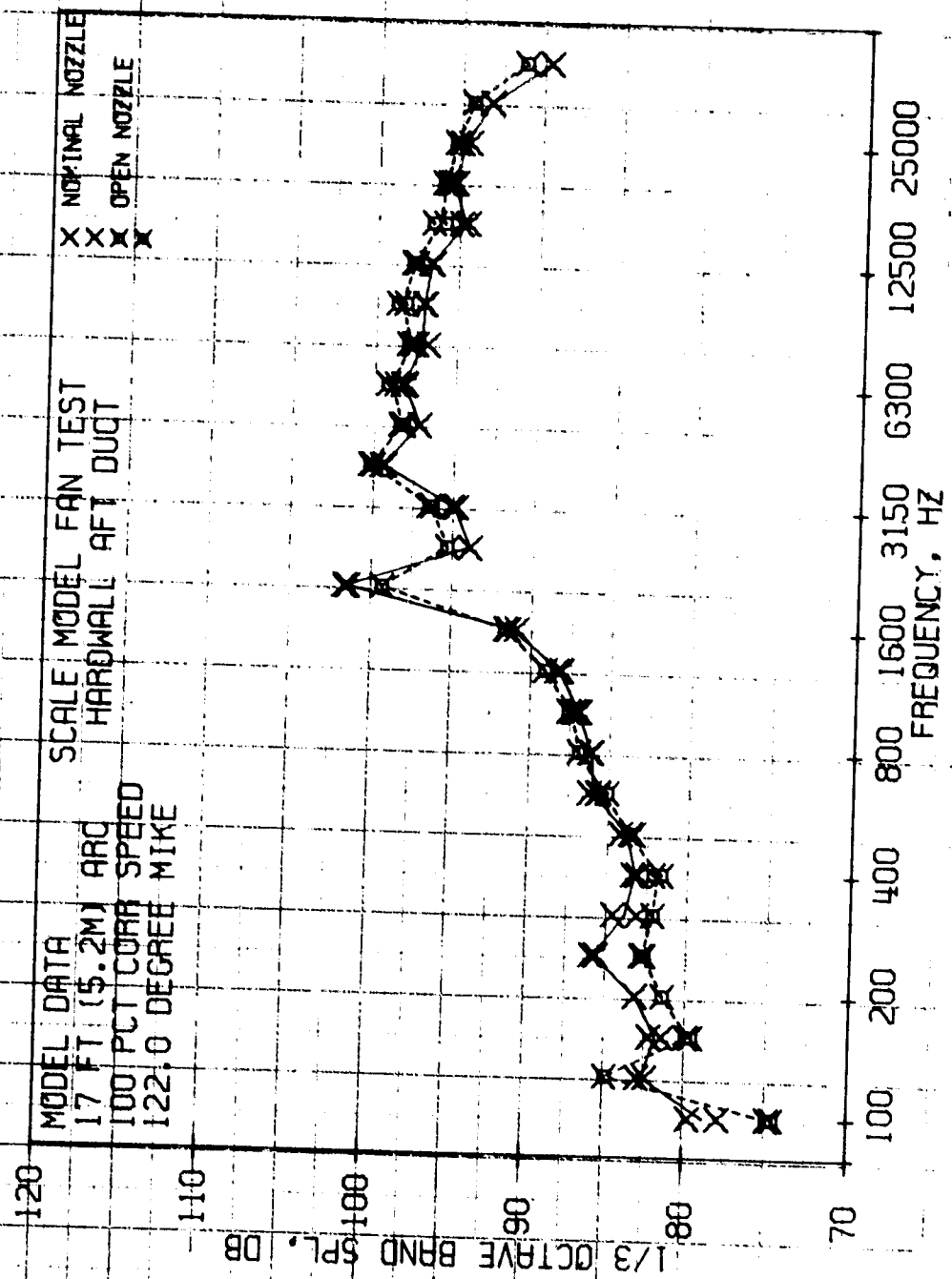


FIGURE 150

## A line drawing of a sword, showing the blade, hilt, and pommel. The blade is long and curved, with a sharp point. The hilt is simple, with a crossguard and a pommel. The drawing is oriented vertically, with the blade pointing upwards.

	OUTER TREATMENT DEPTHS	
	.25 (.64)	.50 (1.27)
IN.	1.5	(3.81)
(cm.)		

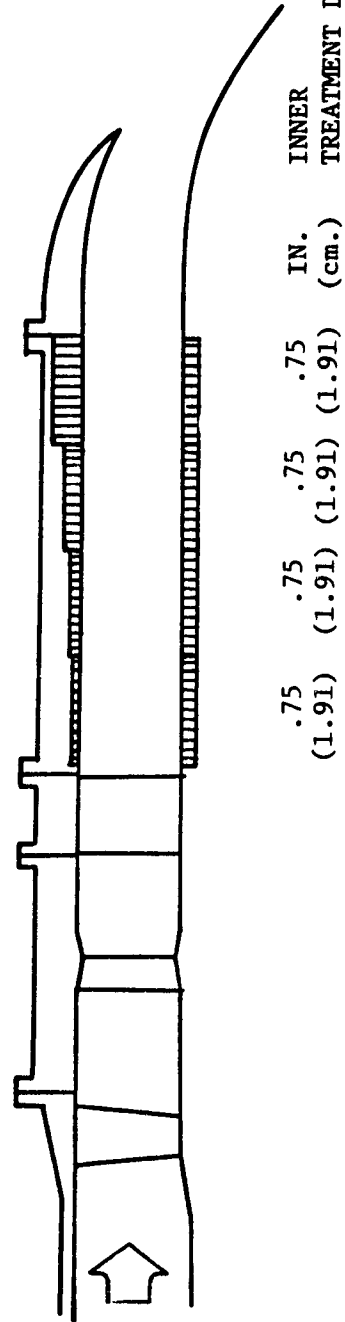


FIGURE 151. 27 PERCENT POROSITY SPLITTER SIMULATION CONFIGURATION

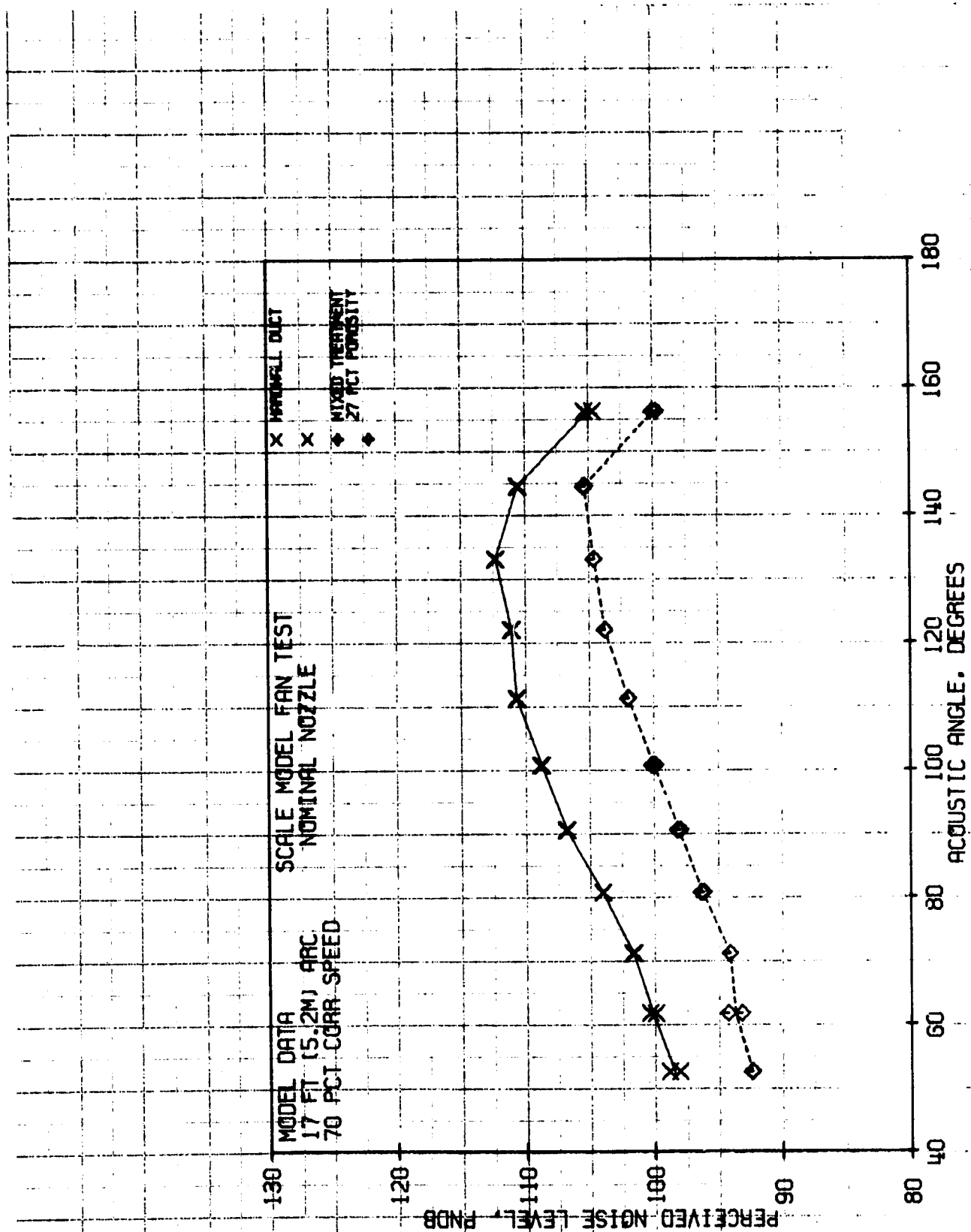


FIGURE 152

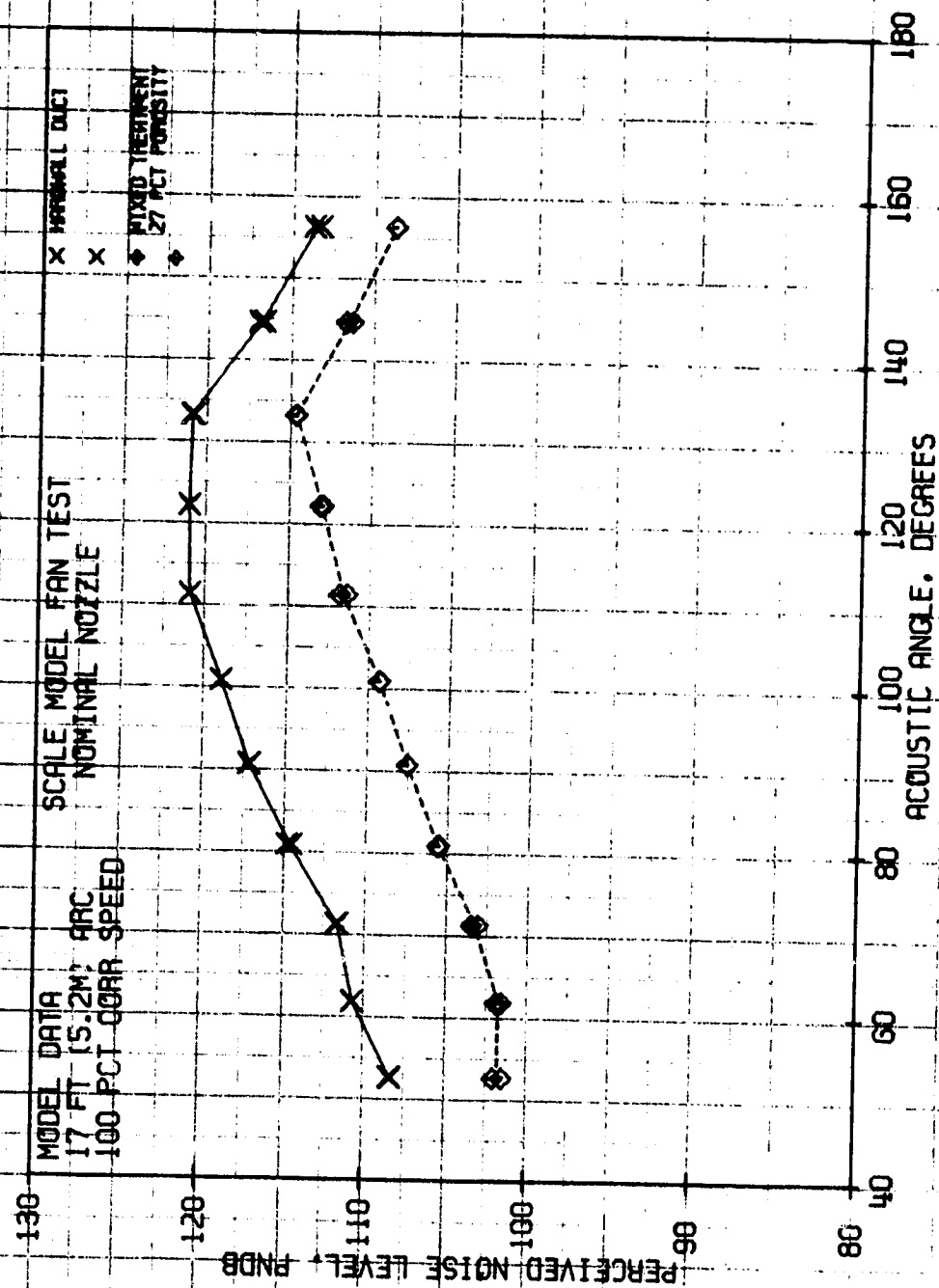


FIGURE 153



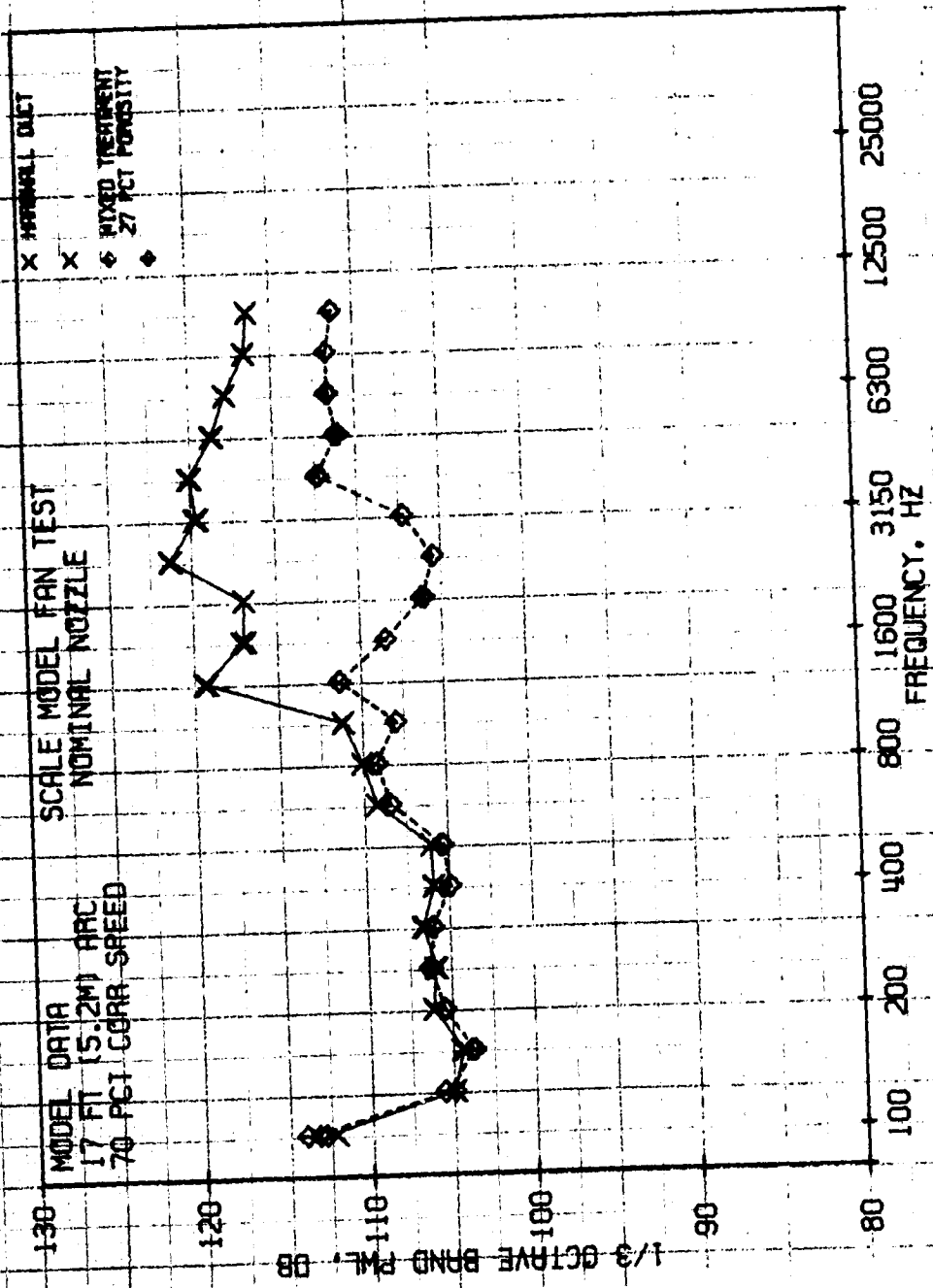


FIGURE 154

79STIMPRT

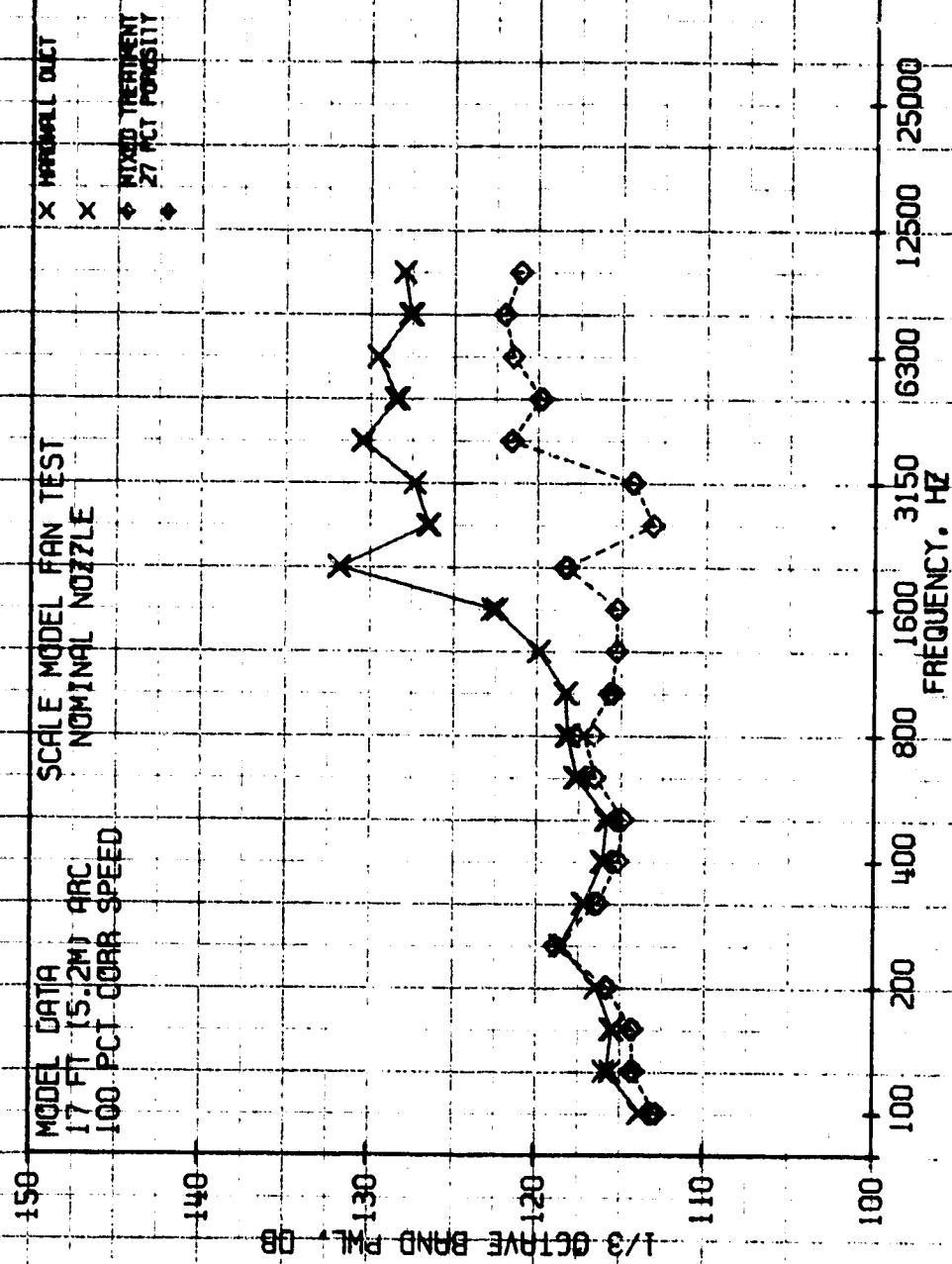


FIGURE 155

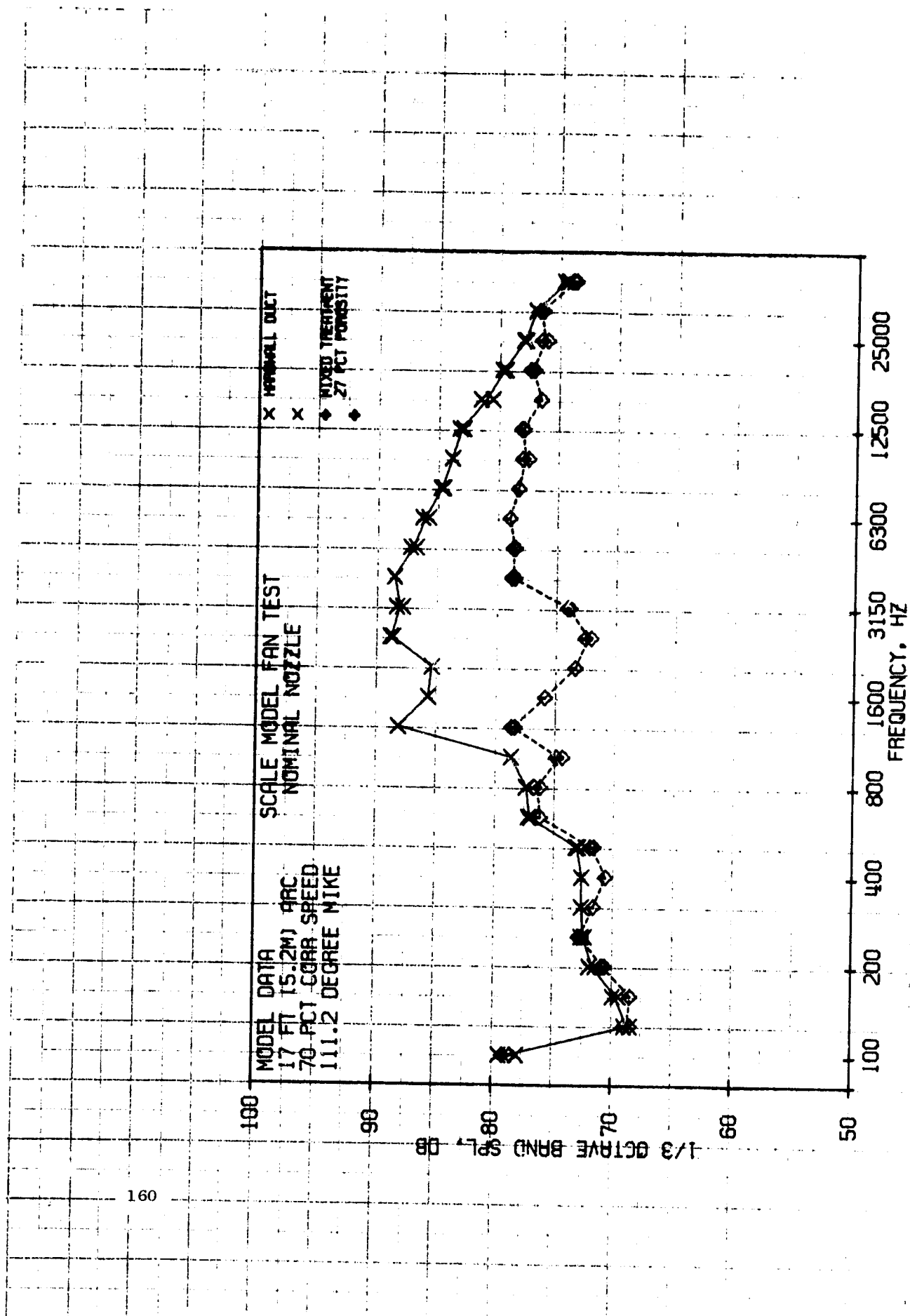


FIGURE 156

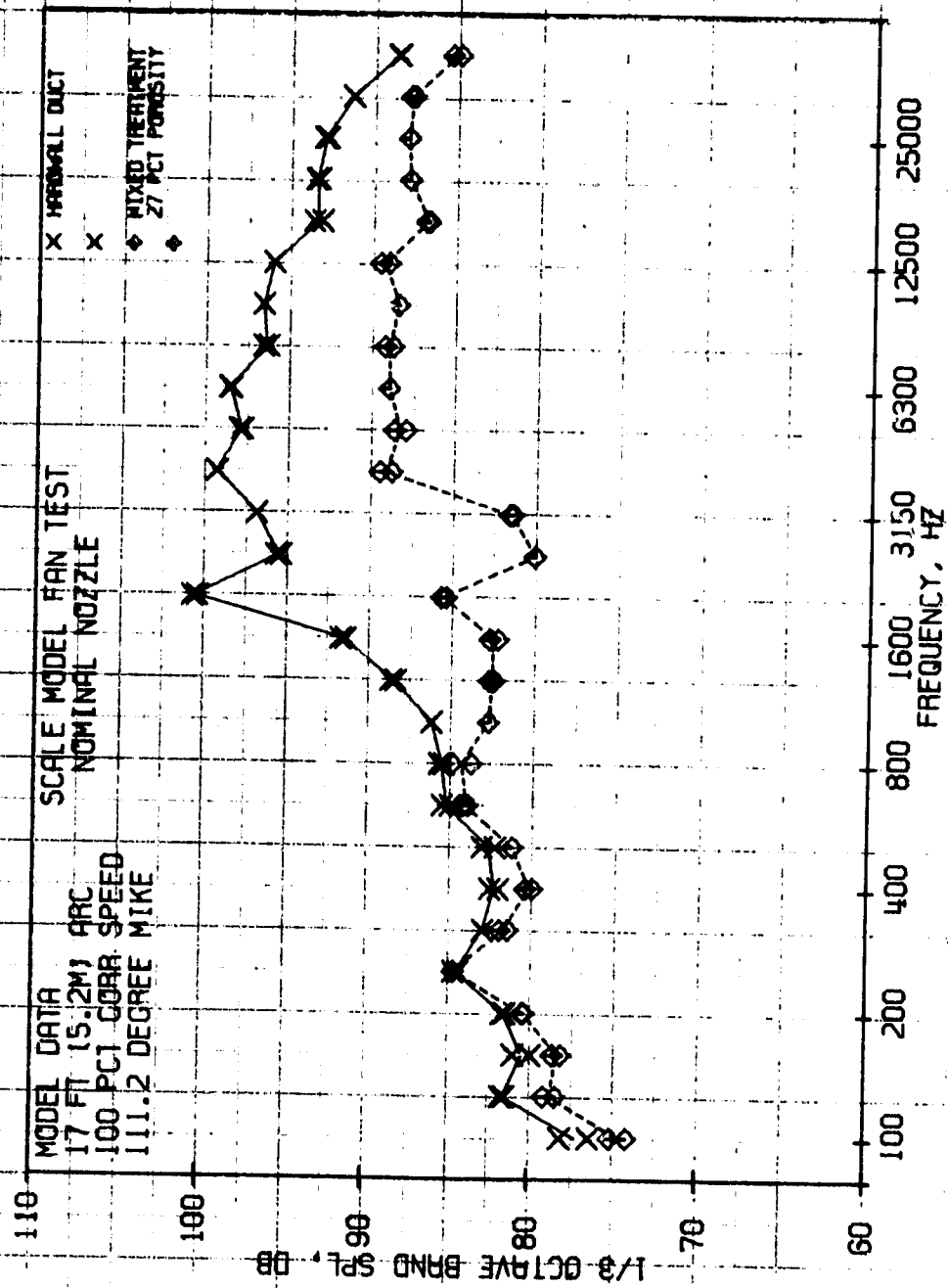


FIGURE 157

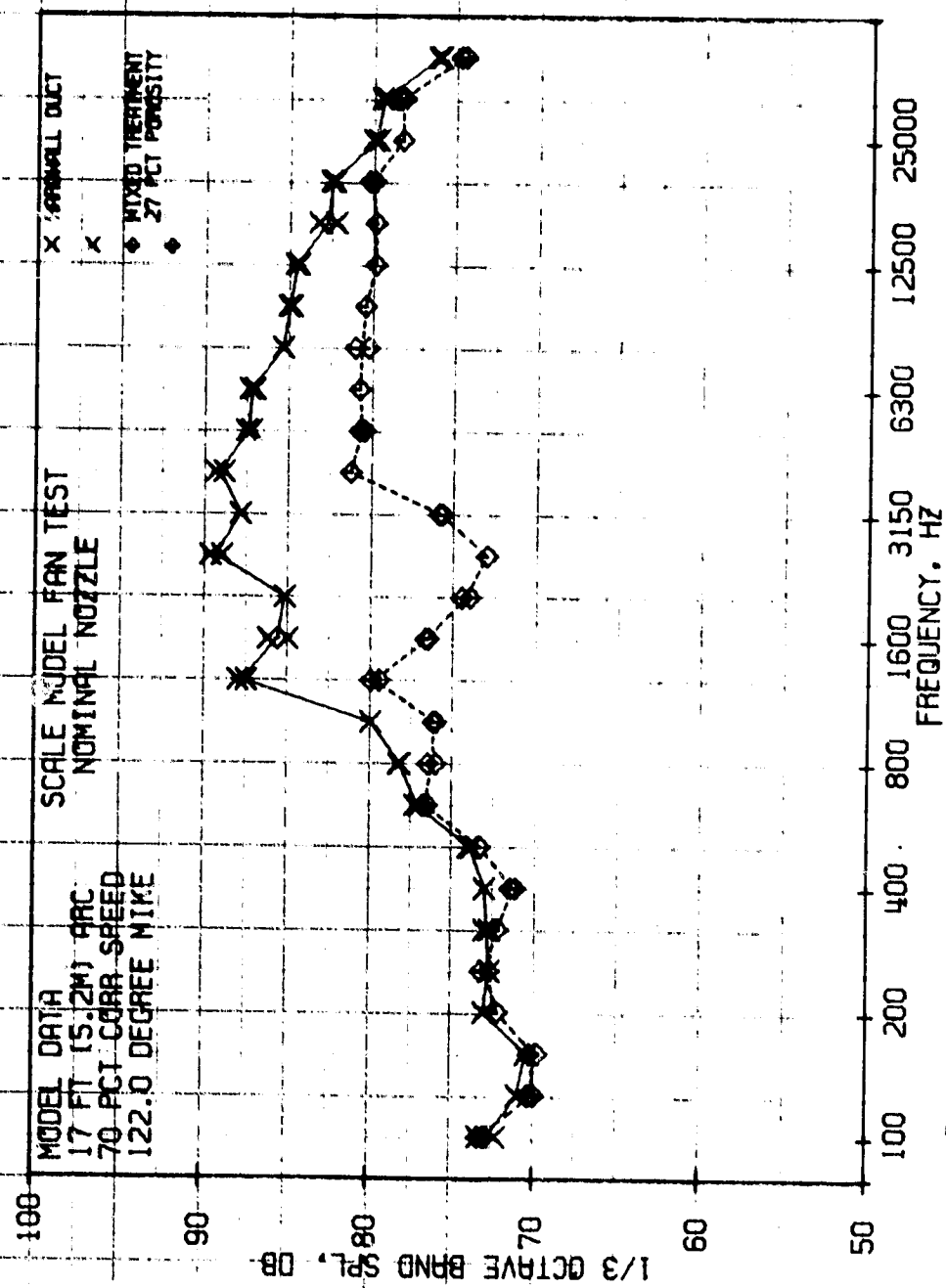


FIGURE 158

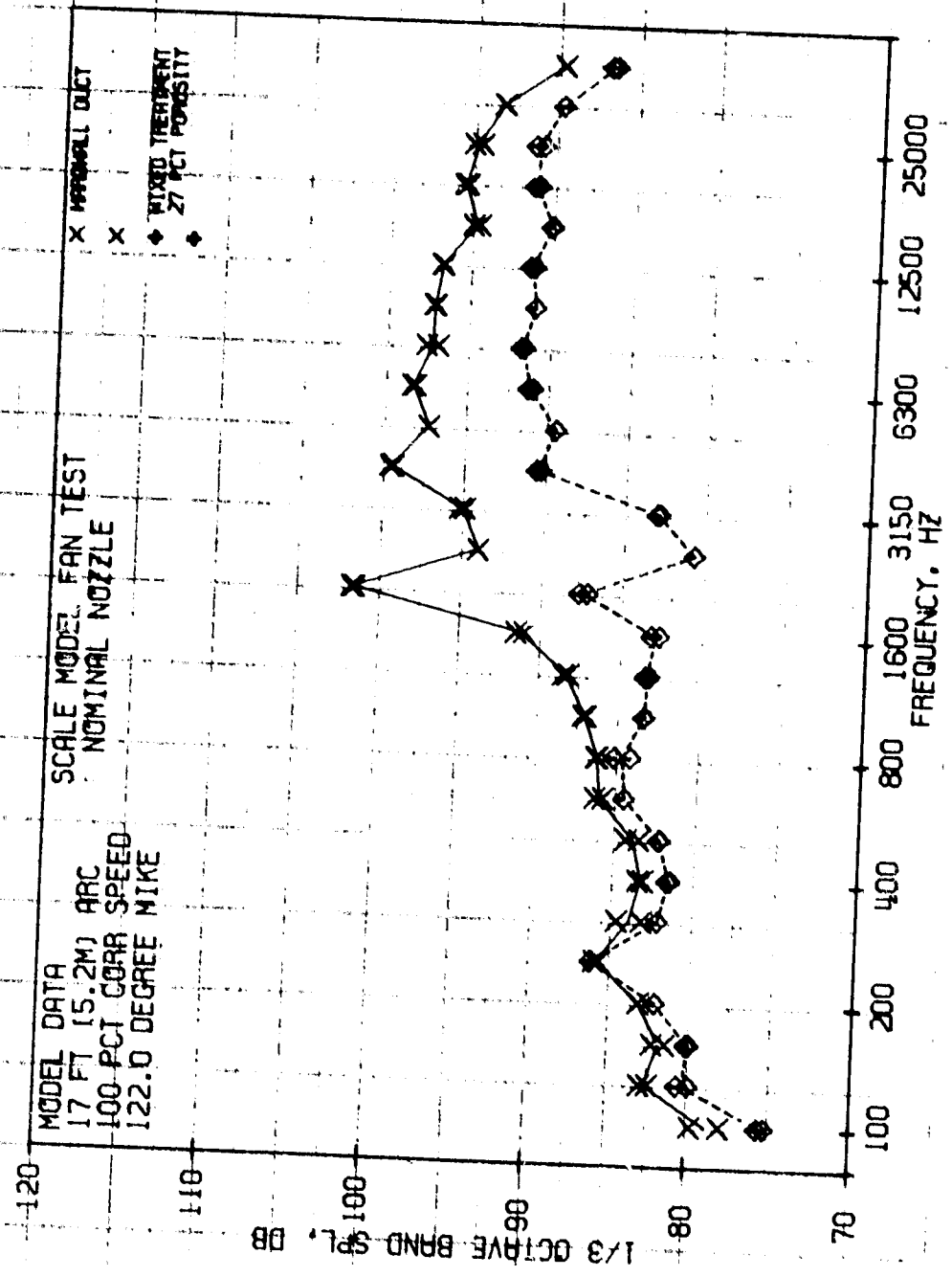
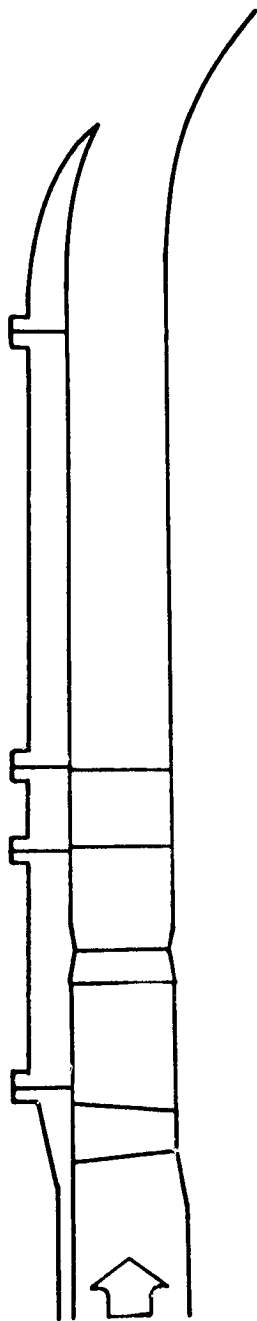


FIGURE 159

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1A, POROSITY = 12%

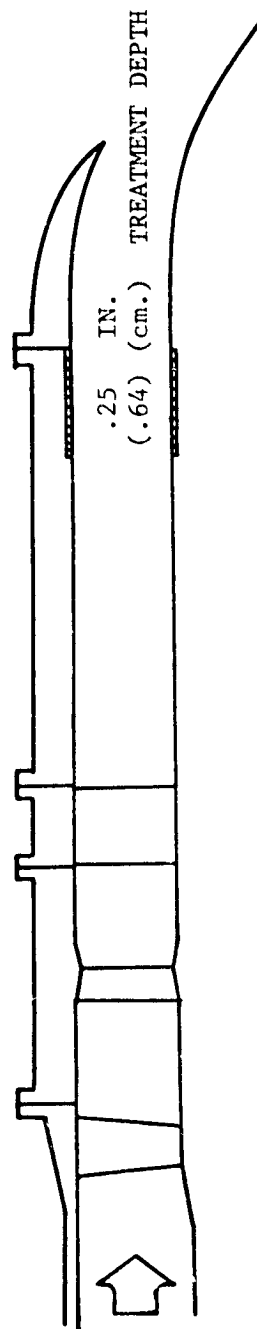


FIGURE 16G.  $L/H = 1.15$ , 12 PERCENT POROSITY, .25 (.64 cm) INCH CONFIGURATION

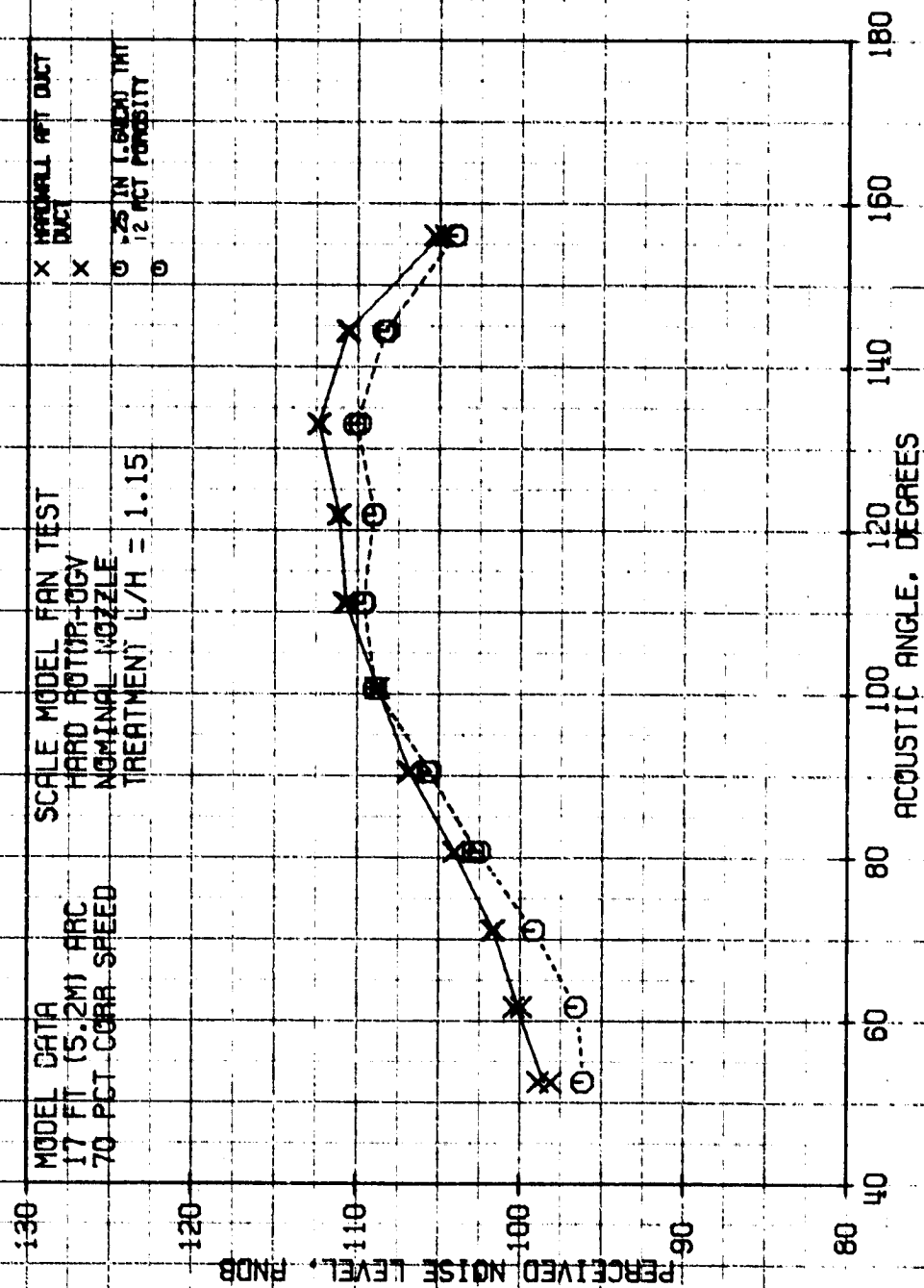


FIGURE 161



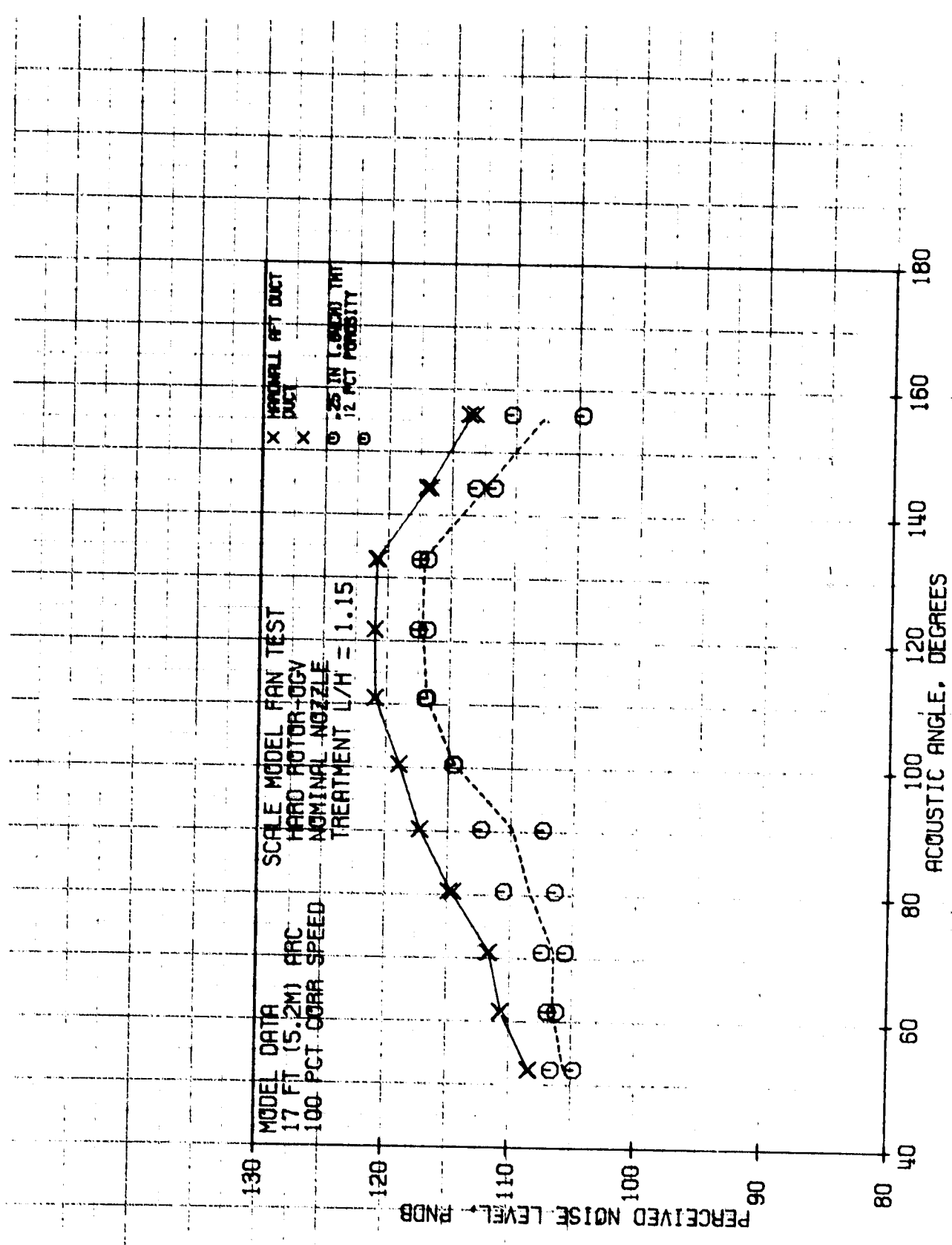


FIGURE 162

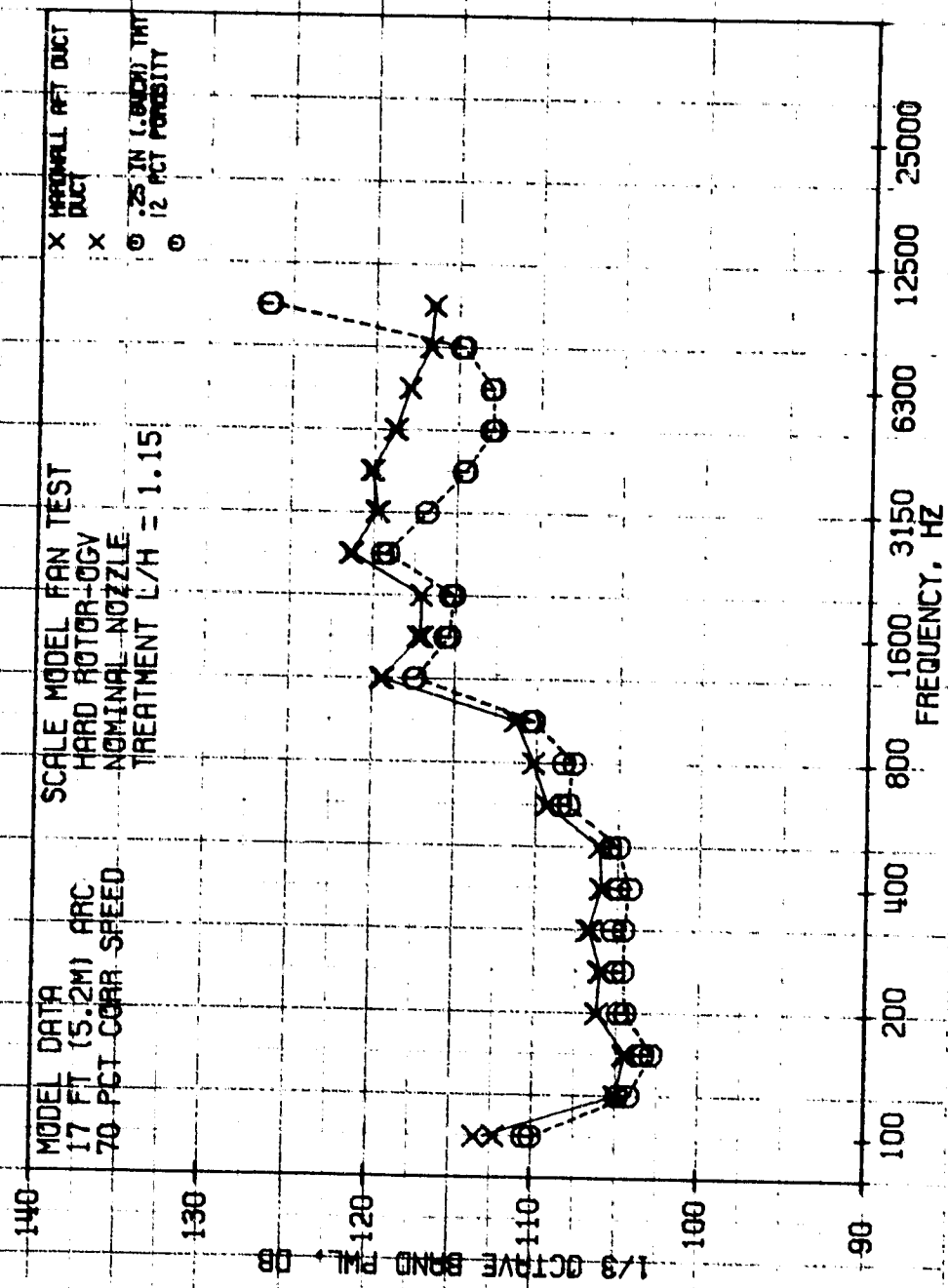


FIGURE 163

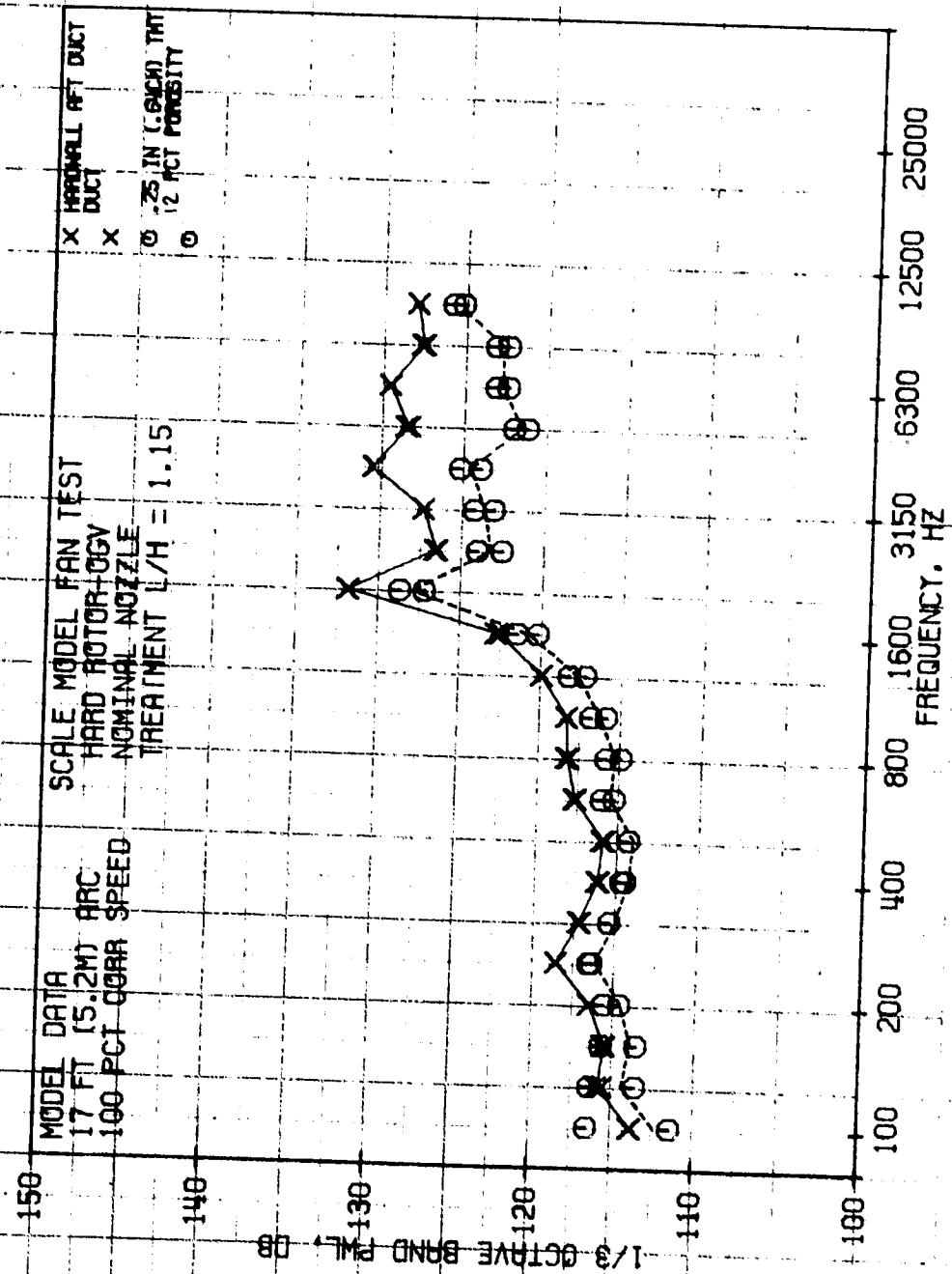


FIGURE 164

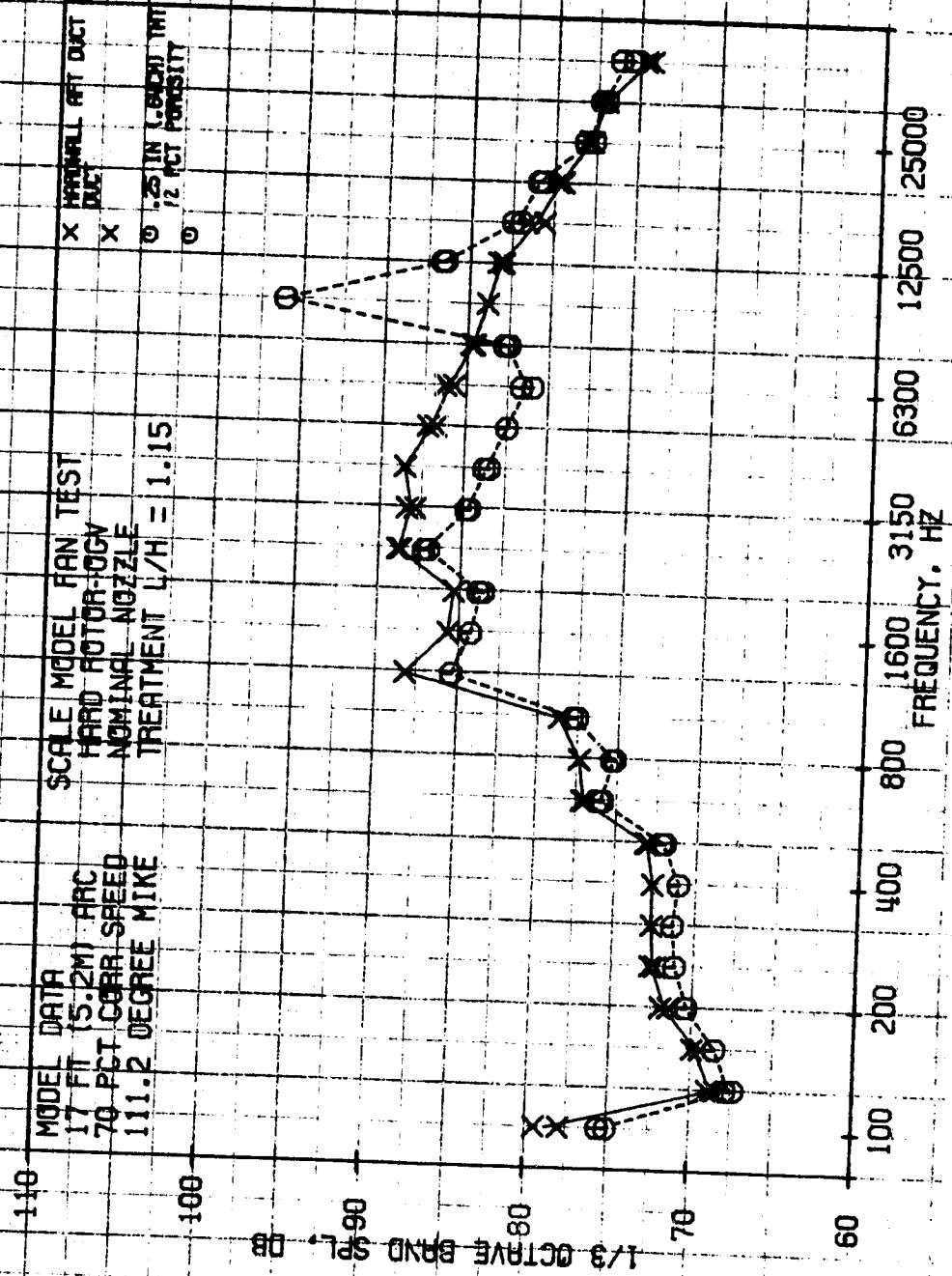


FIGURE 165

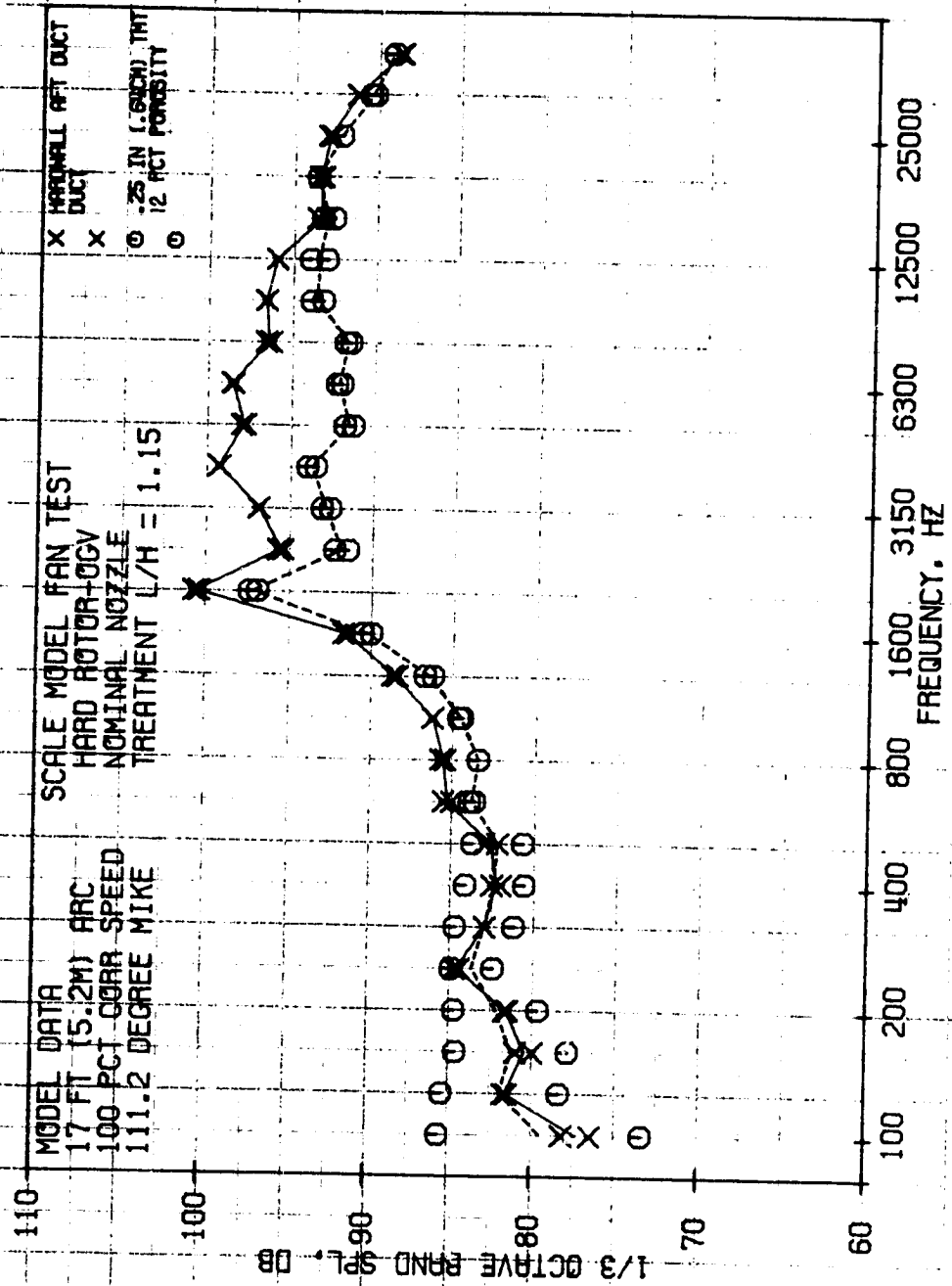


FIGURE 166

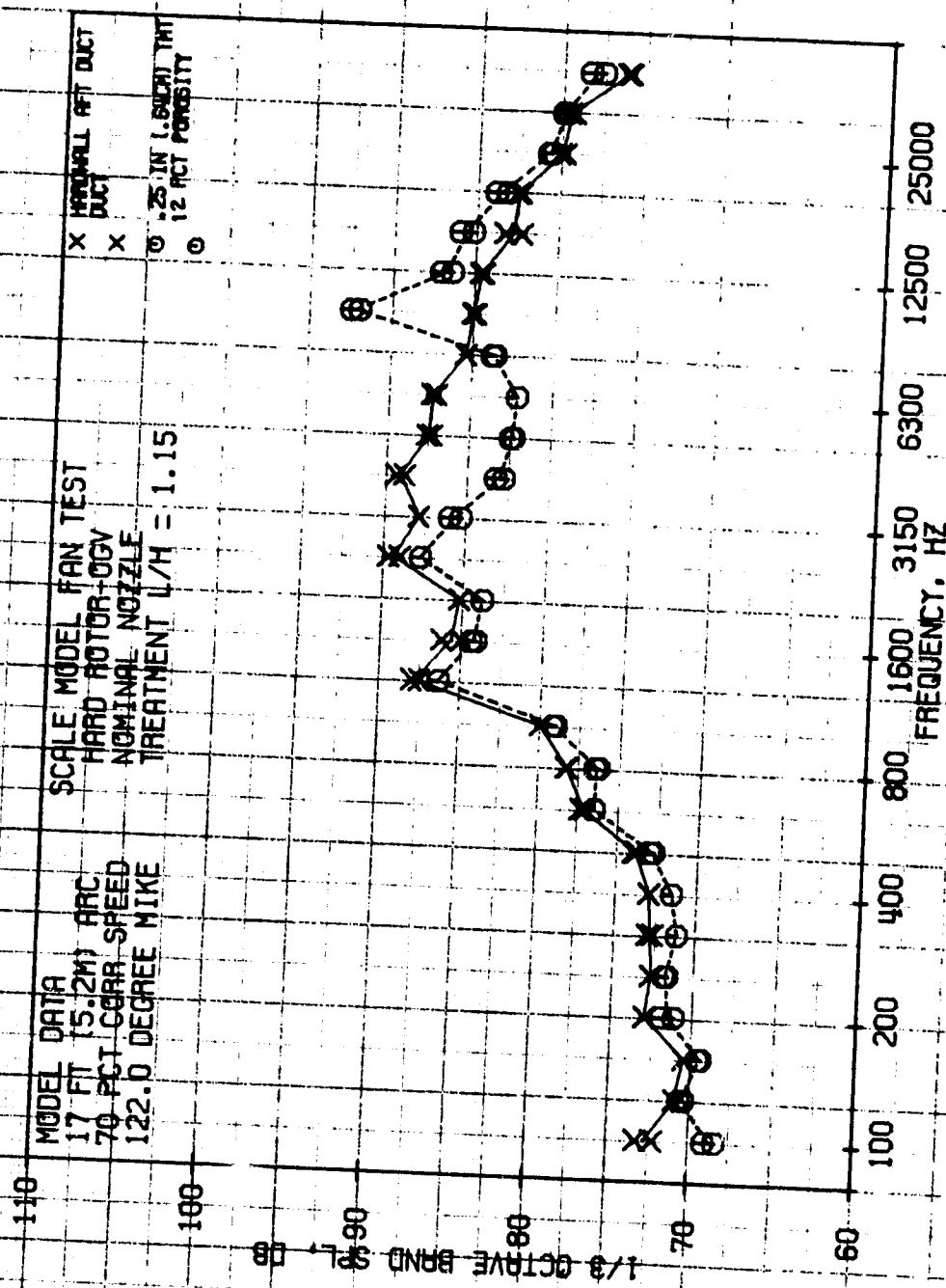


FIGURE 167

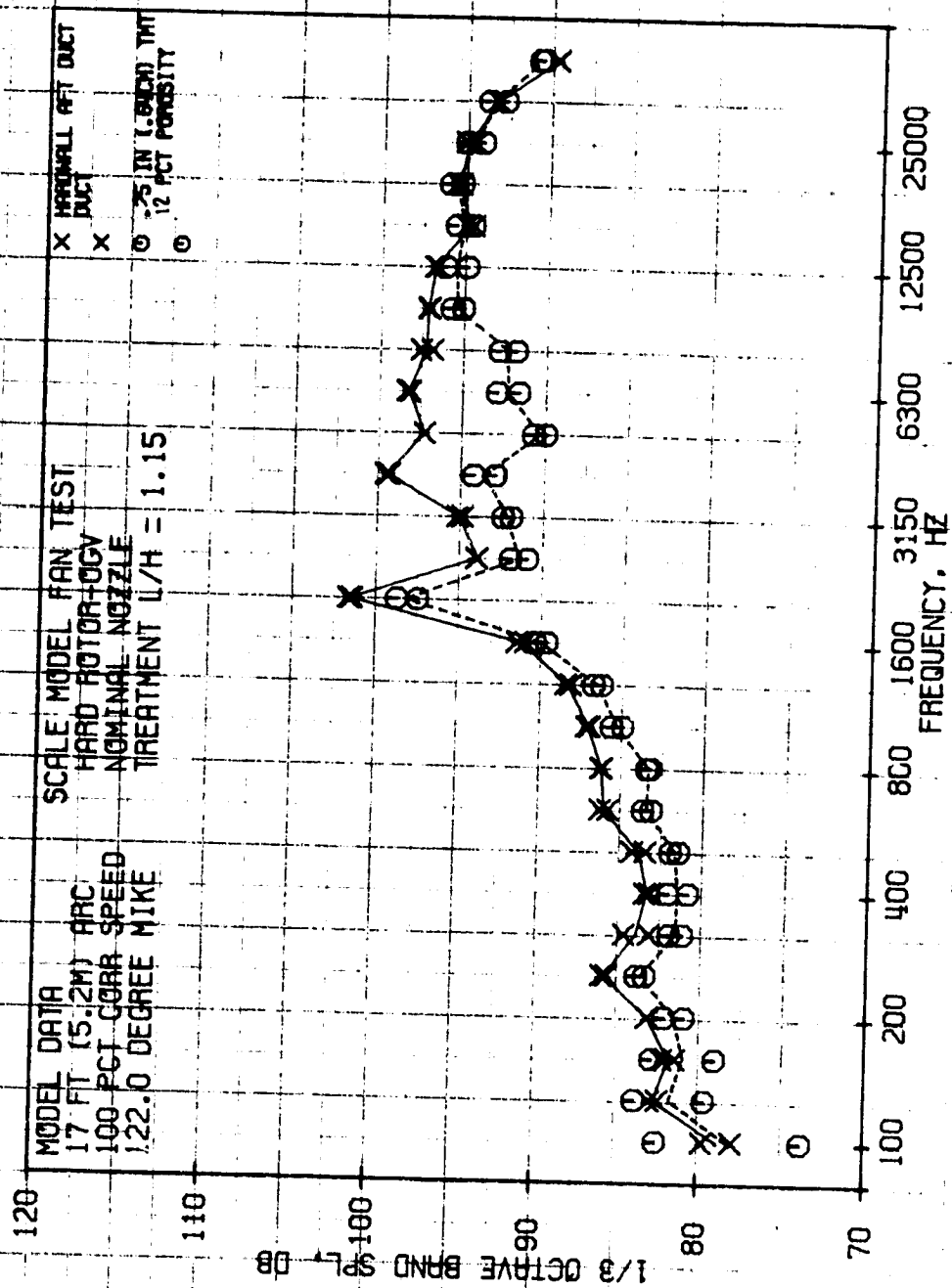
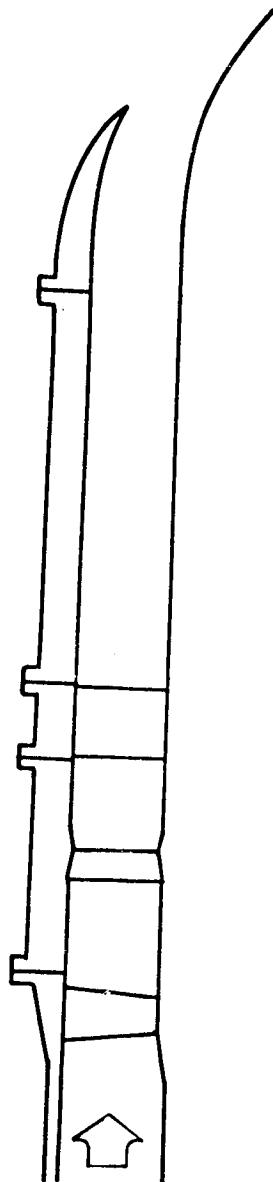


FIGURE 168

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1B, POROSITY = 12%

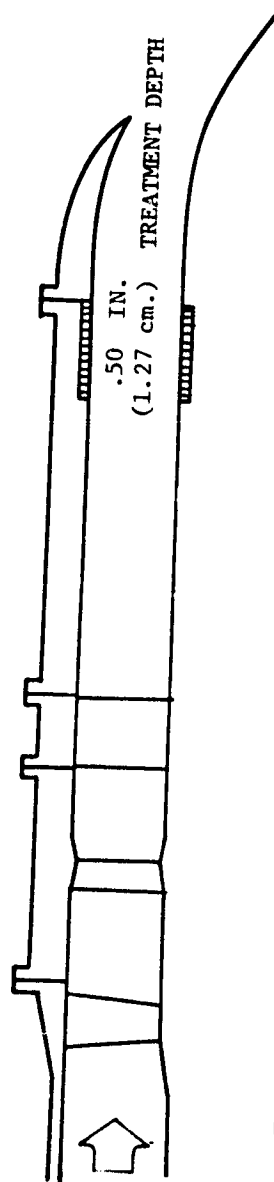


FIGURE 169.  $L/H = 1.15$ , 12 PERCENT POROSITY, .5 INCH (1.27 cm) CONFIGURATION



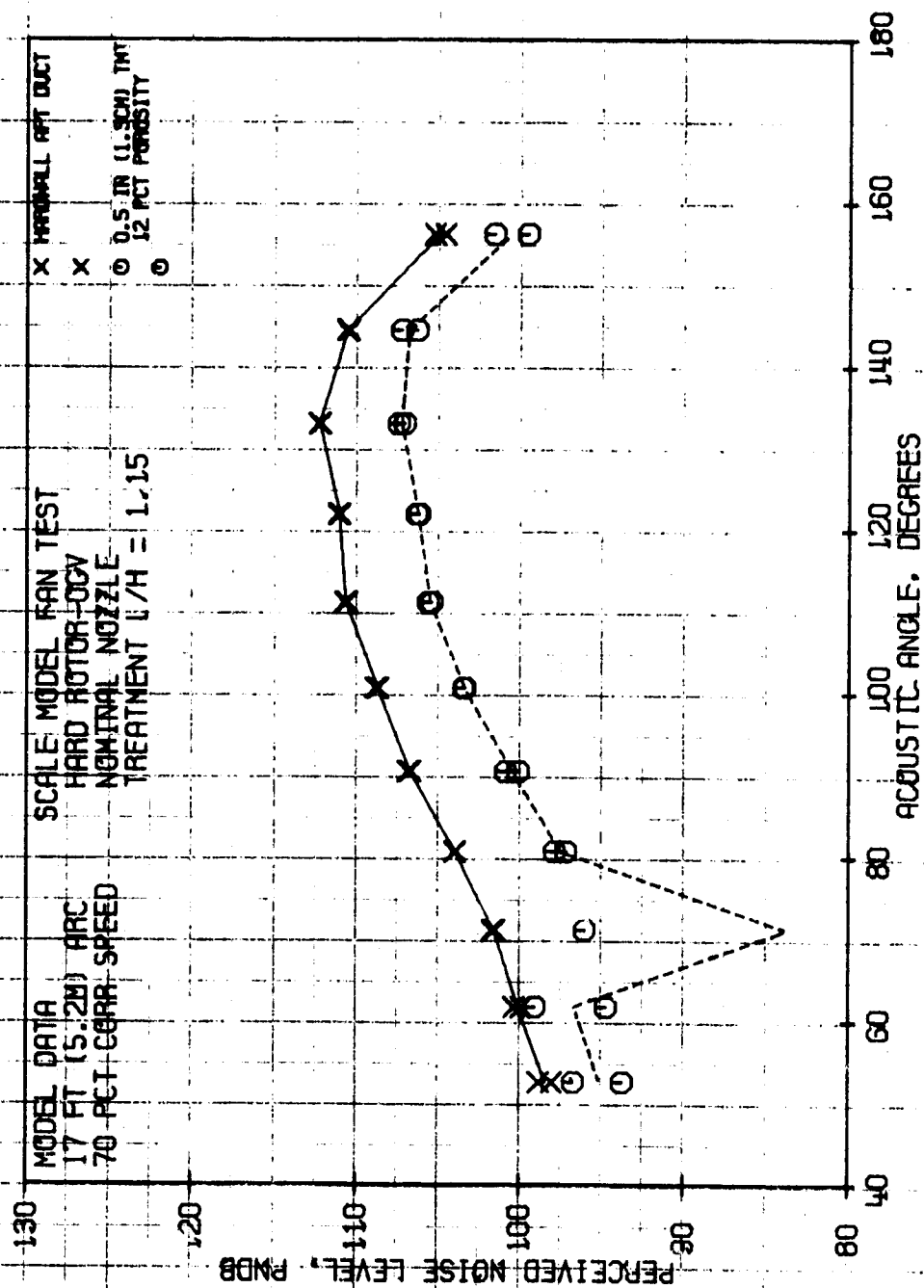


FIGURE 170

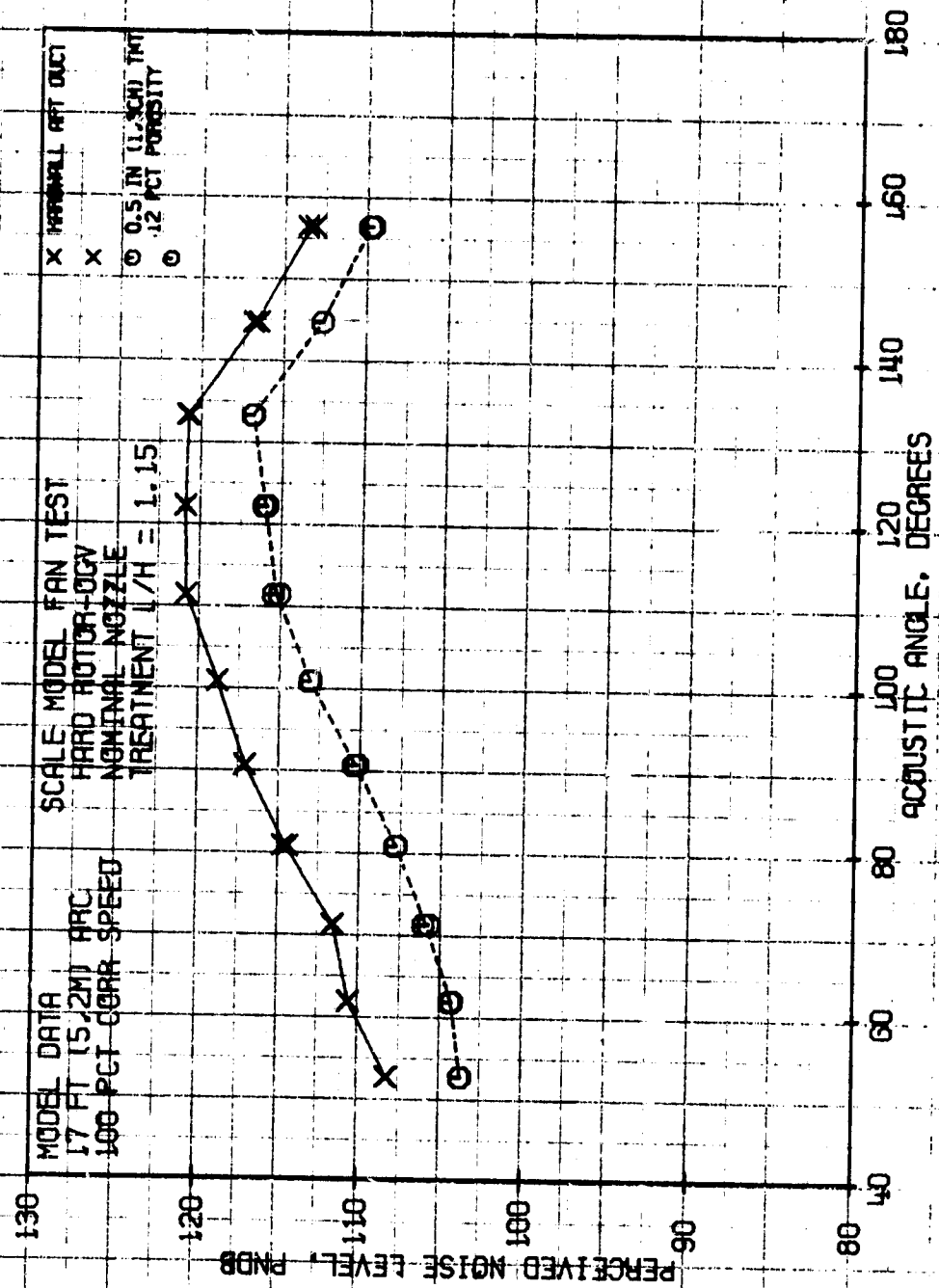


FIGURE 171

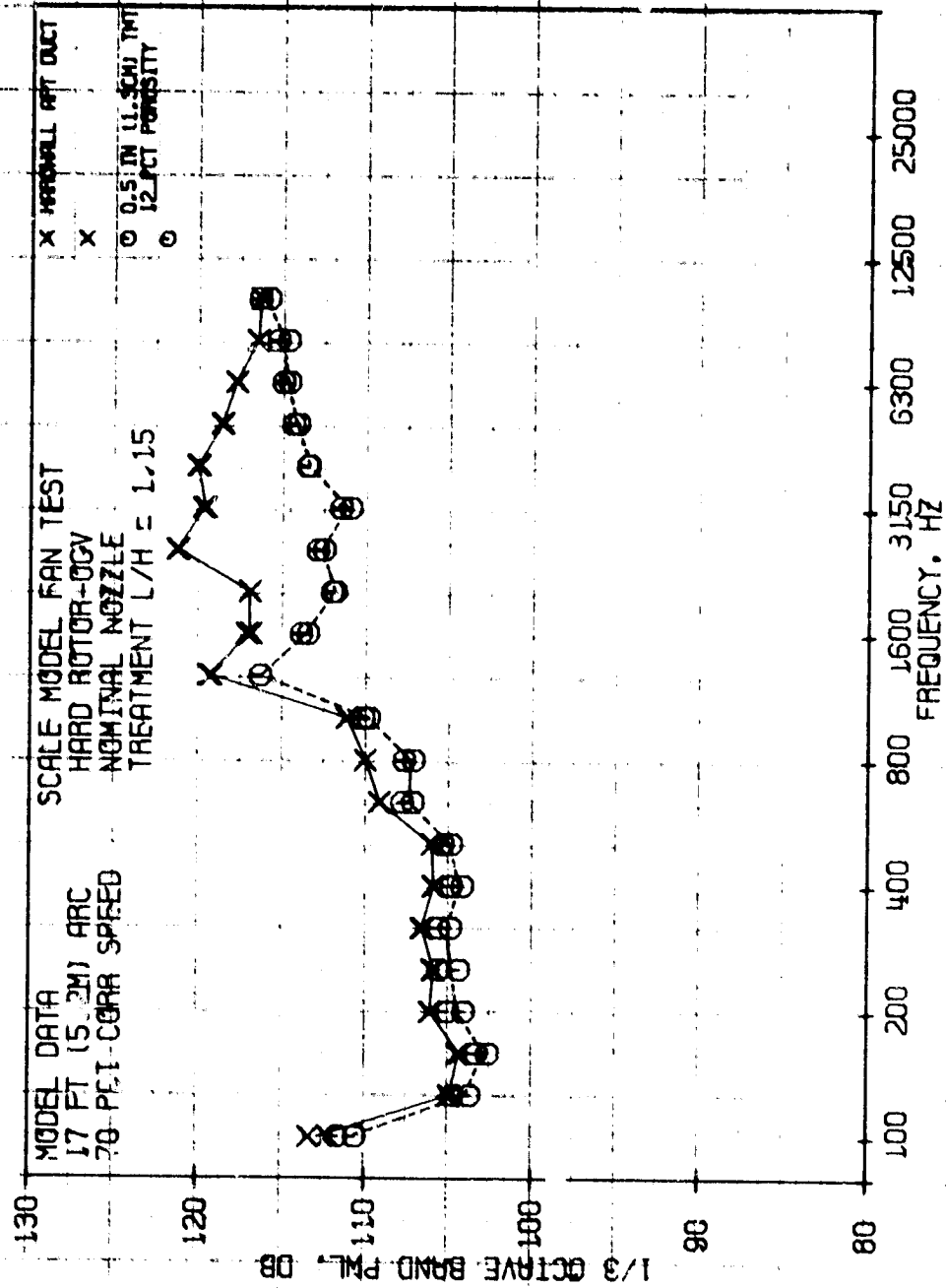


FIGURE 172

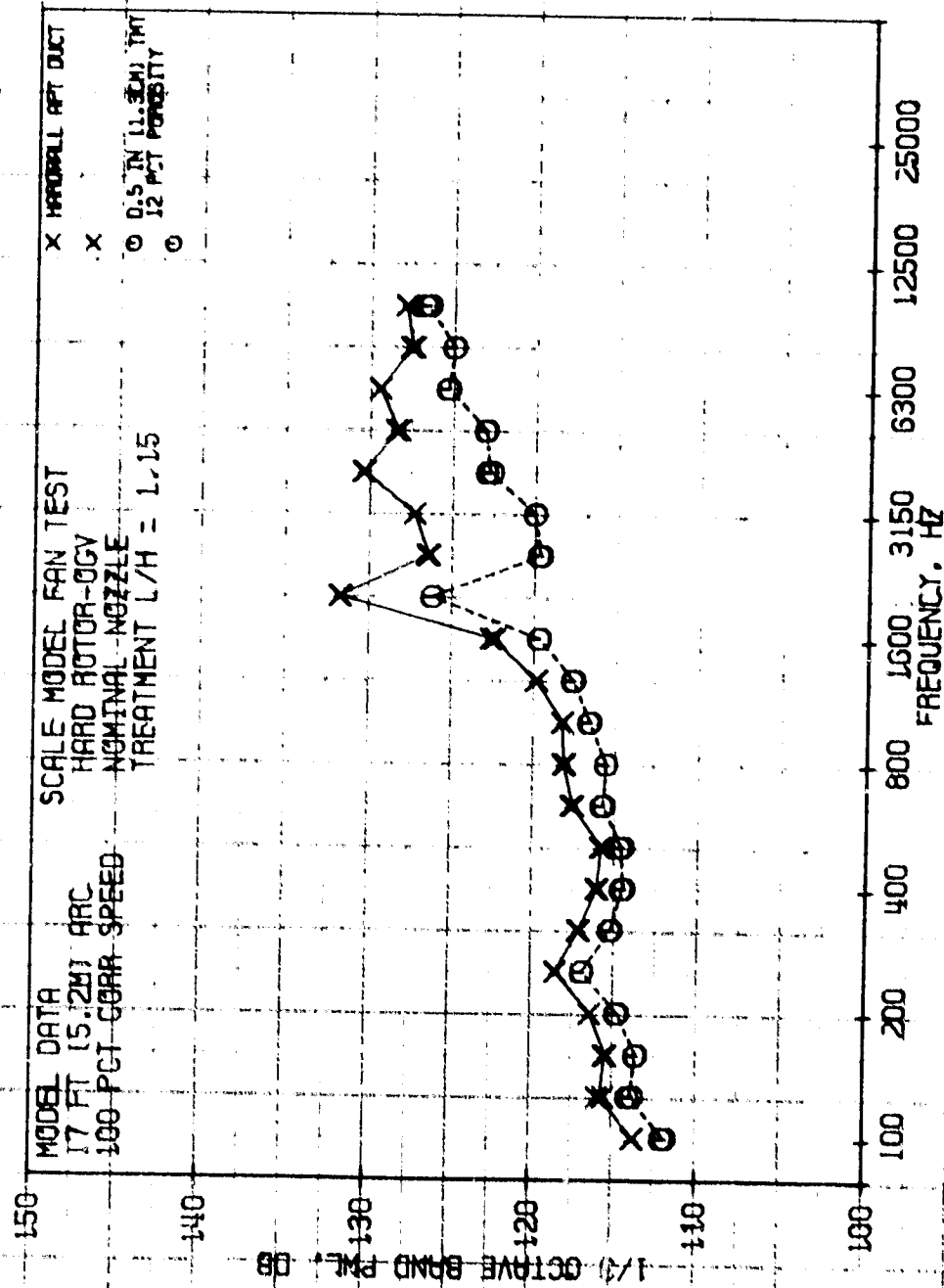


FIGURE 173

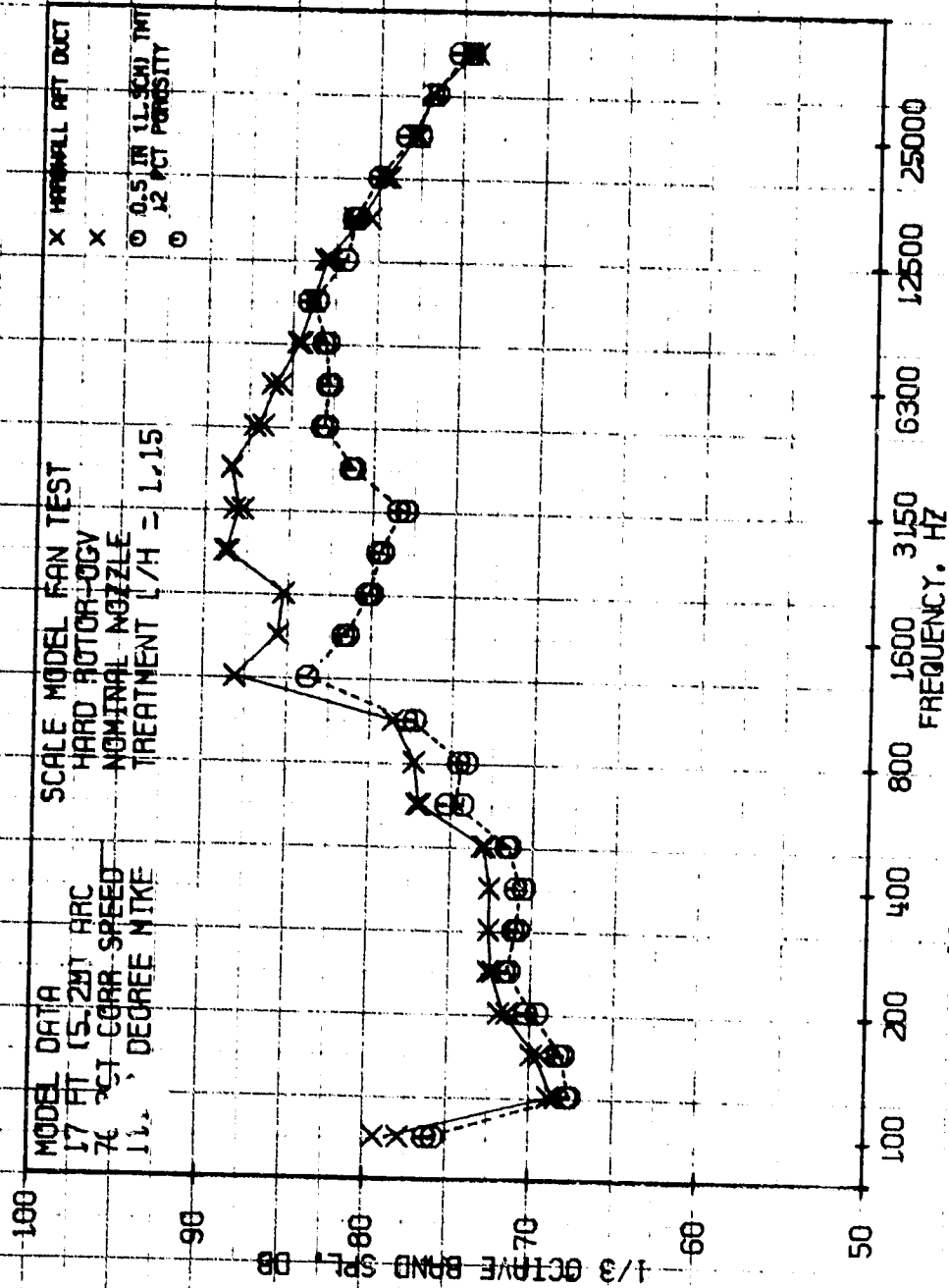


FIGURE 174

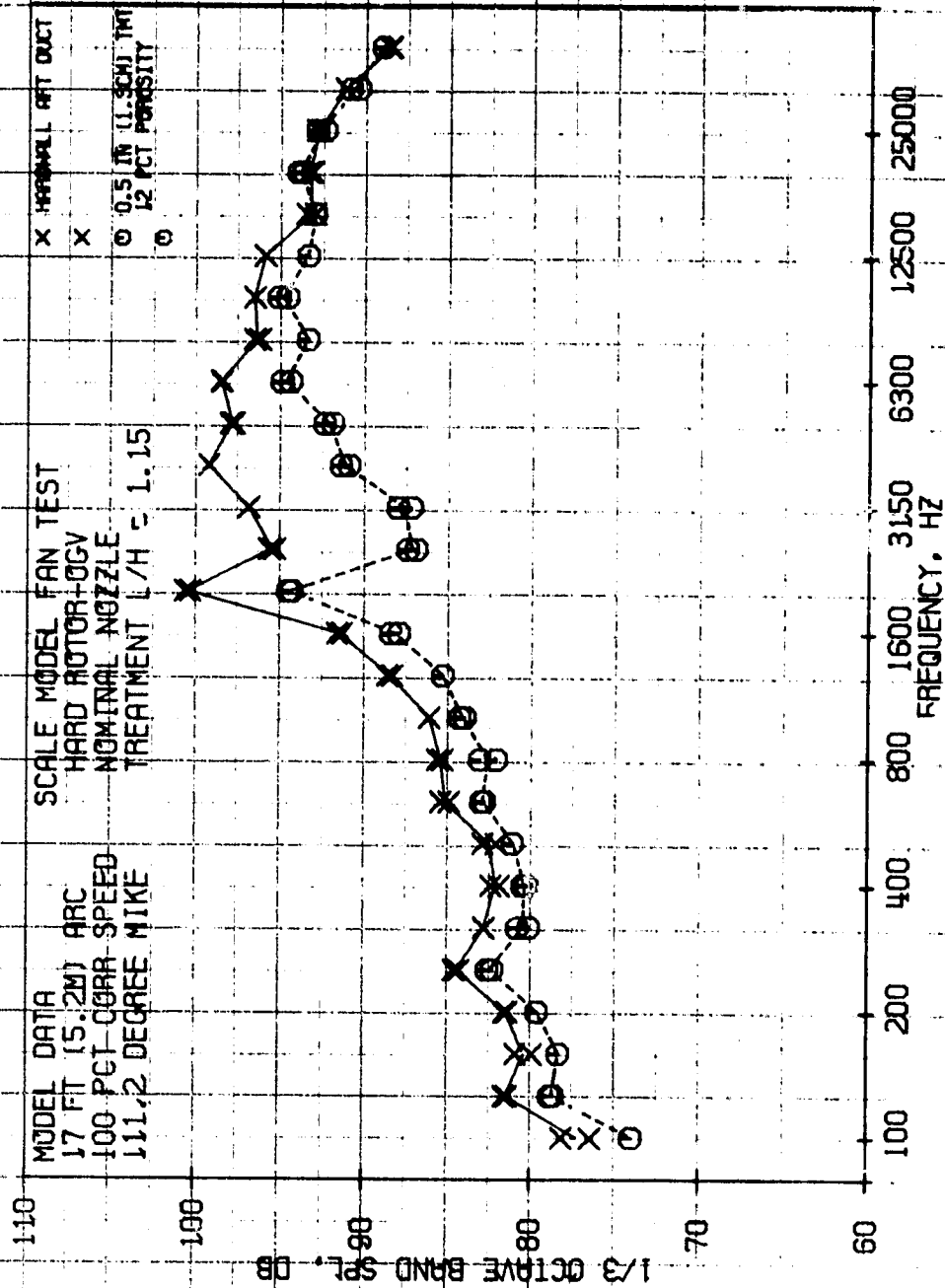


FIGURE 175

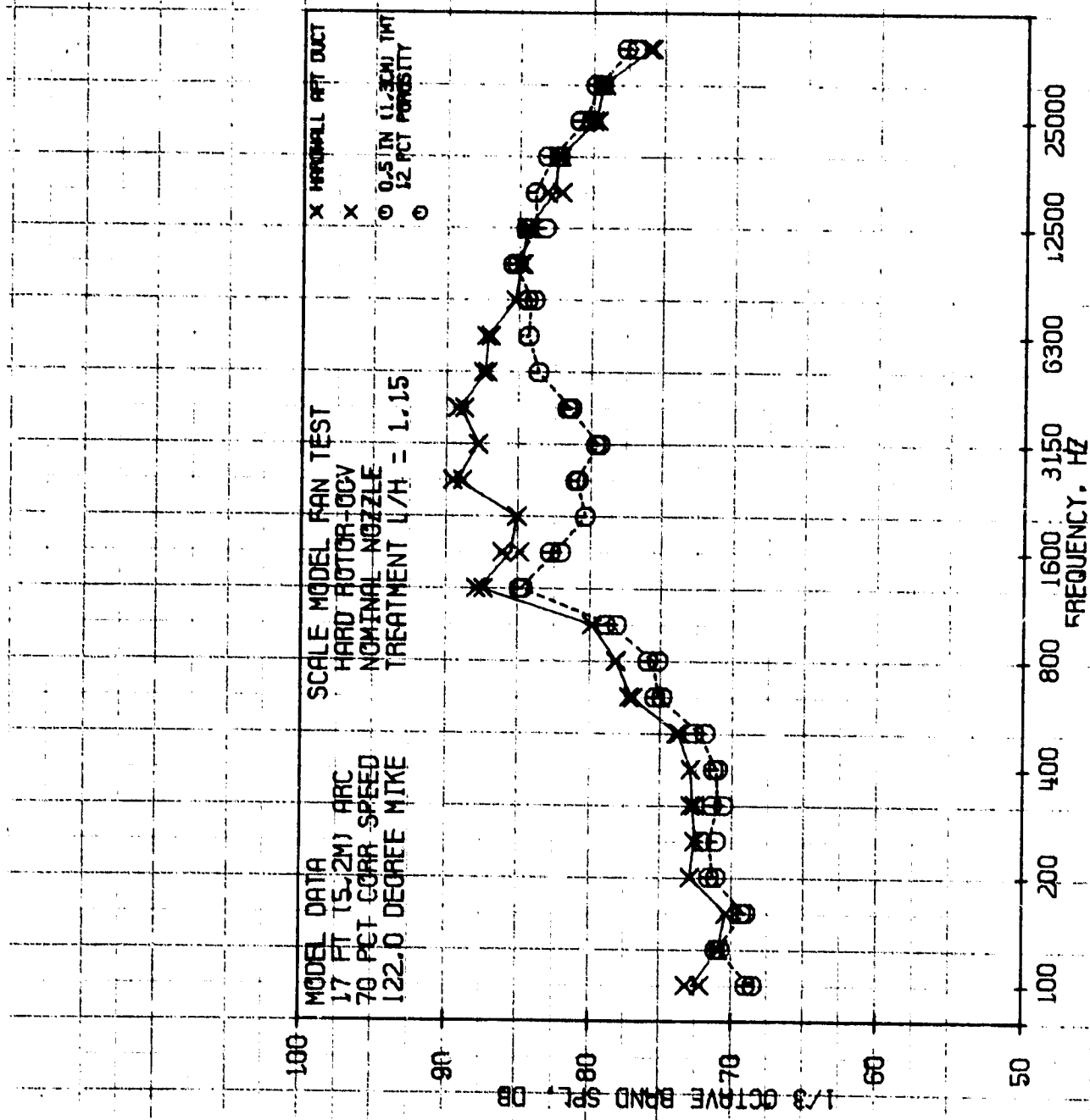


FIGURE 176

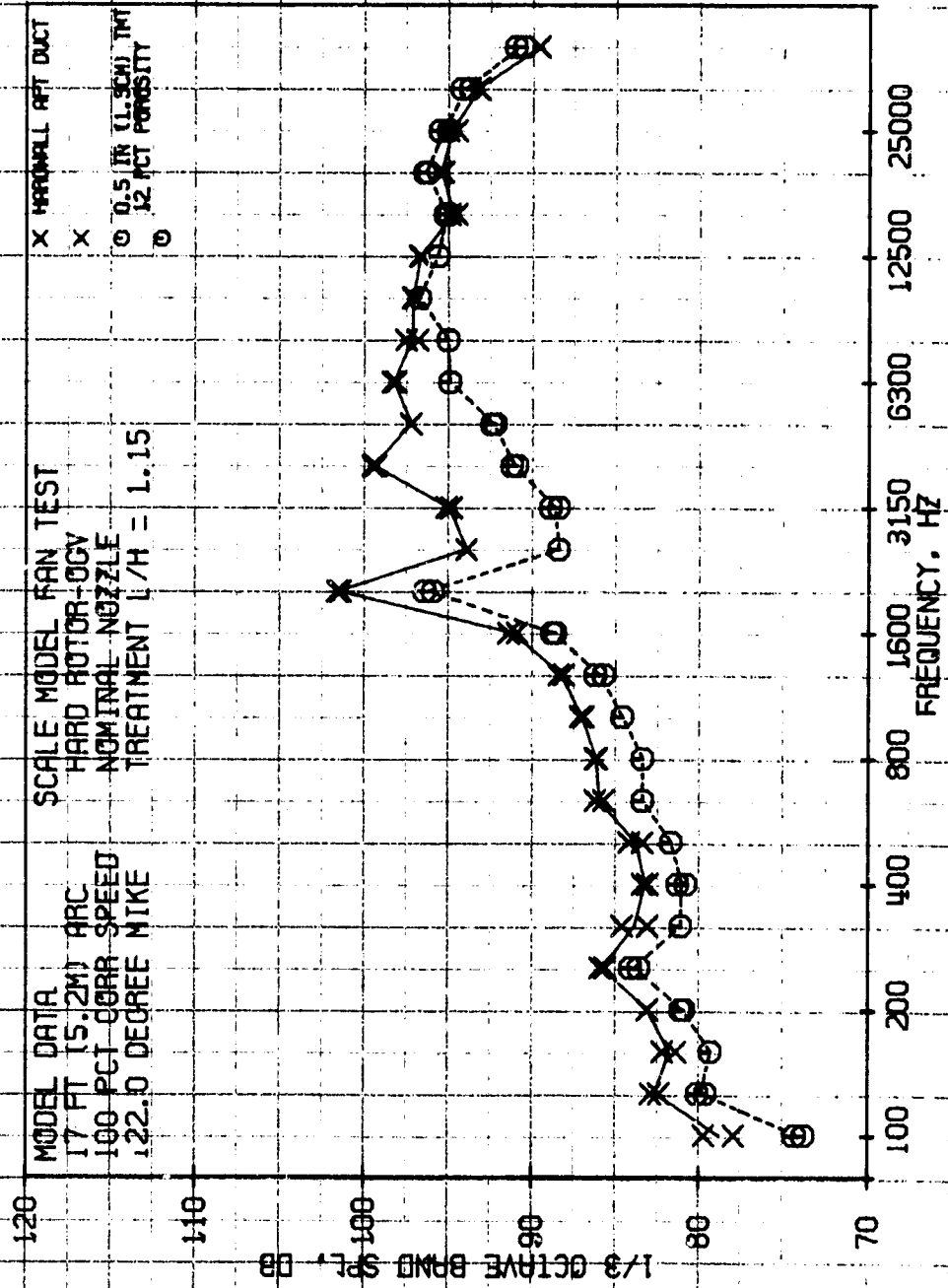
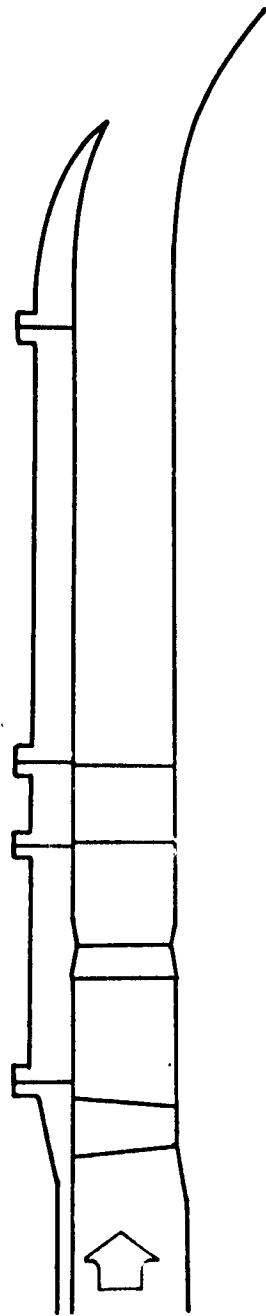


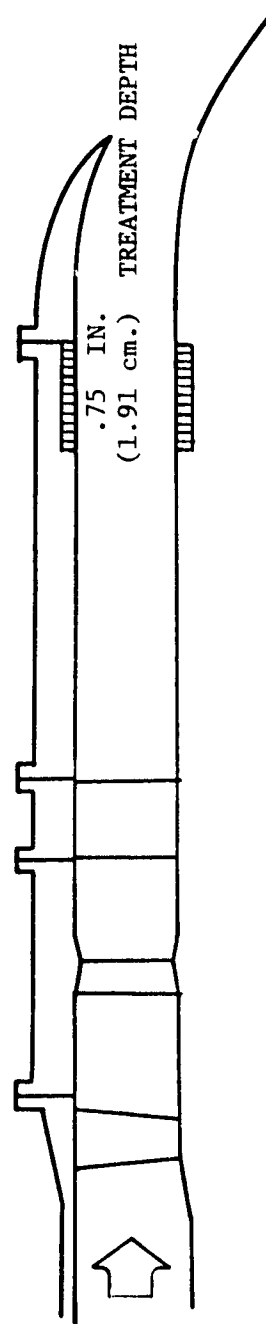
FIGURE 177



CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1C, POROSITY = 12%

FIGURE 178.  $L/H = 1.15$ , 12 PERCENT POROSITY, .75 INCH (1.91 cm) CONFIGURATION

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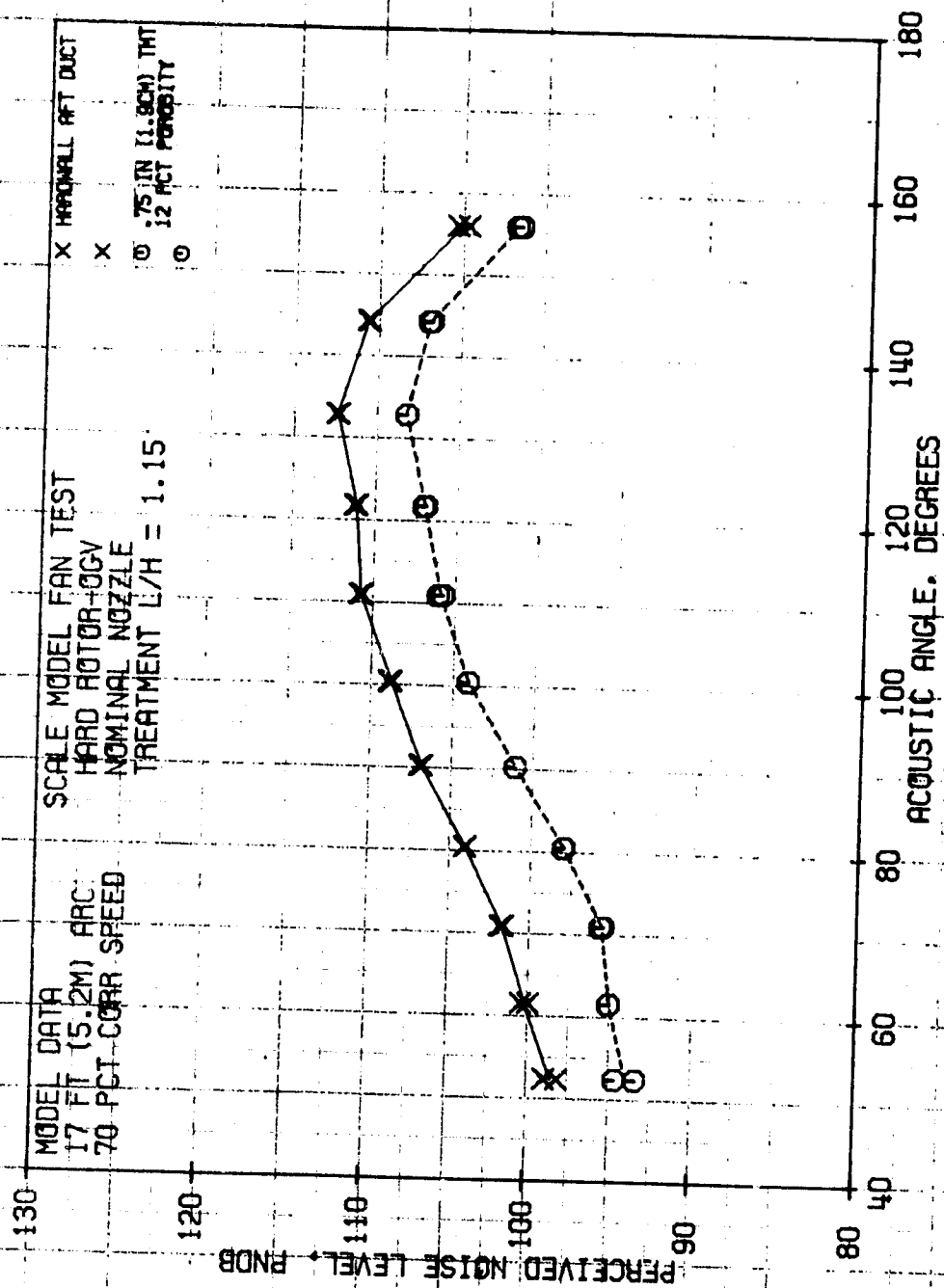


FIGURE 179

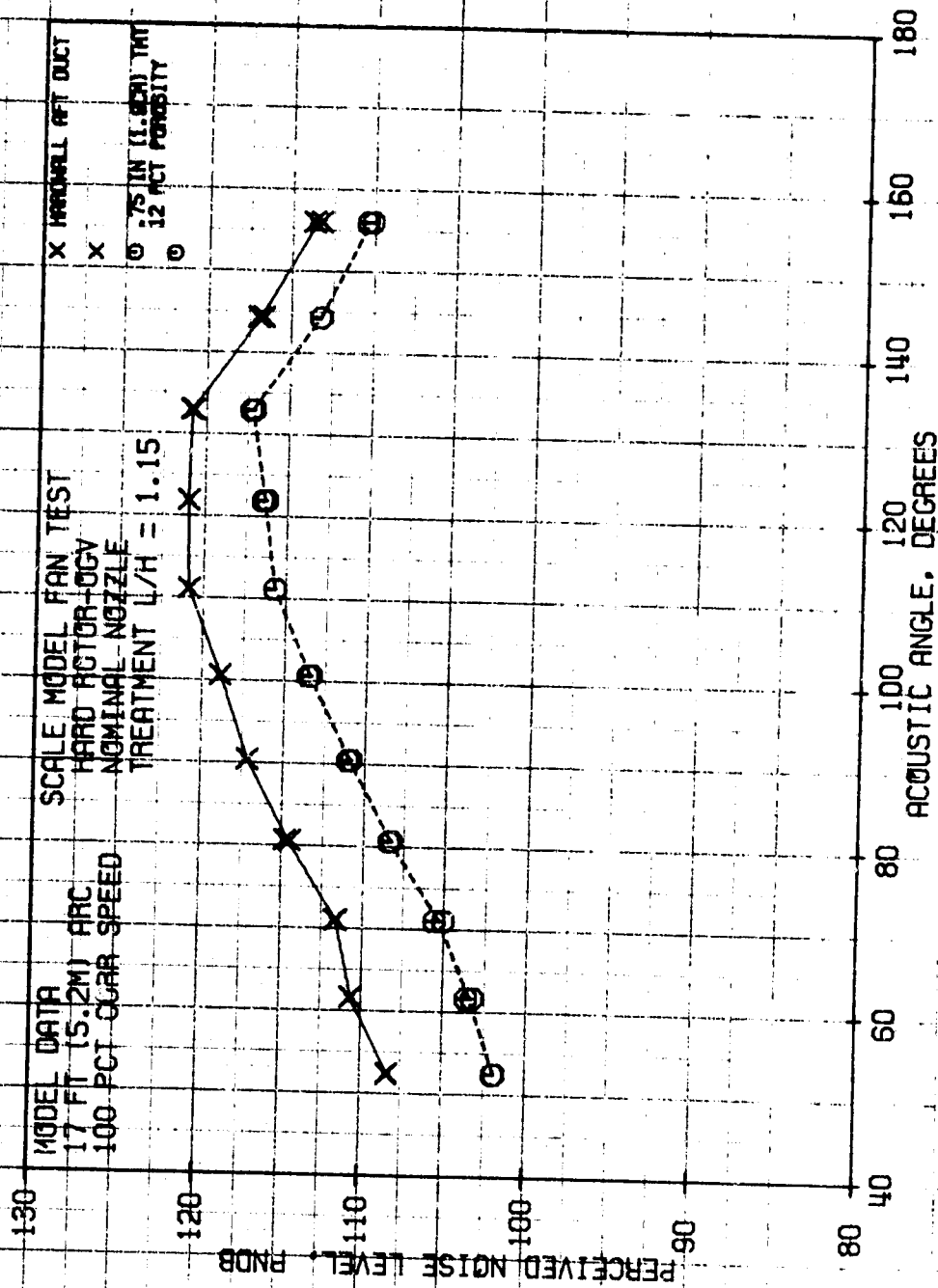


FIGURE 180

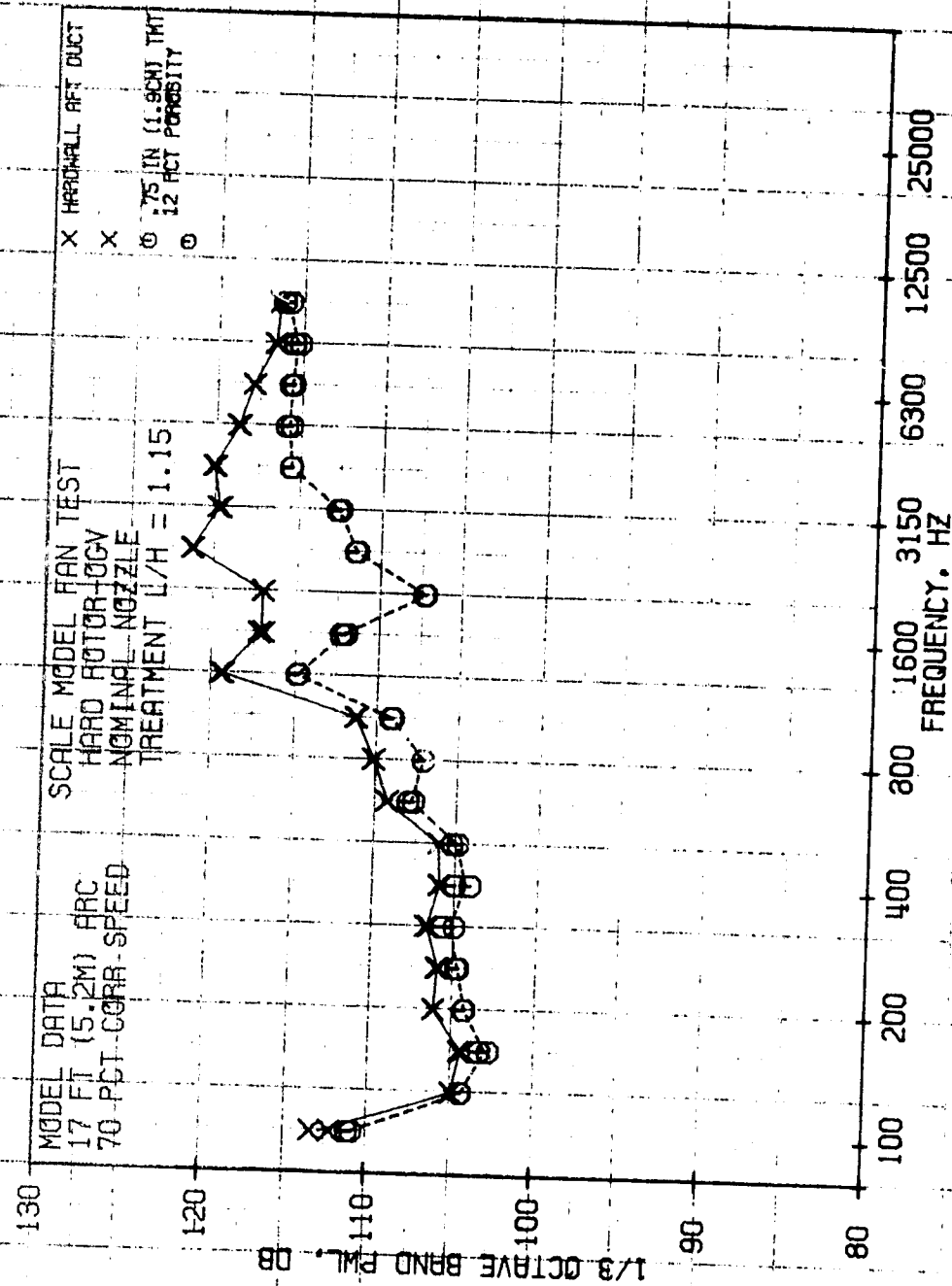


FIGURE 181

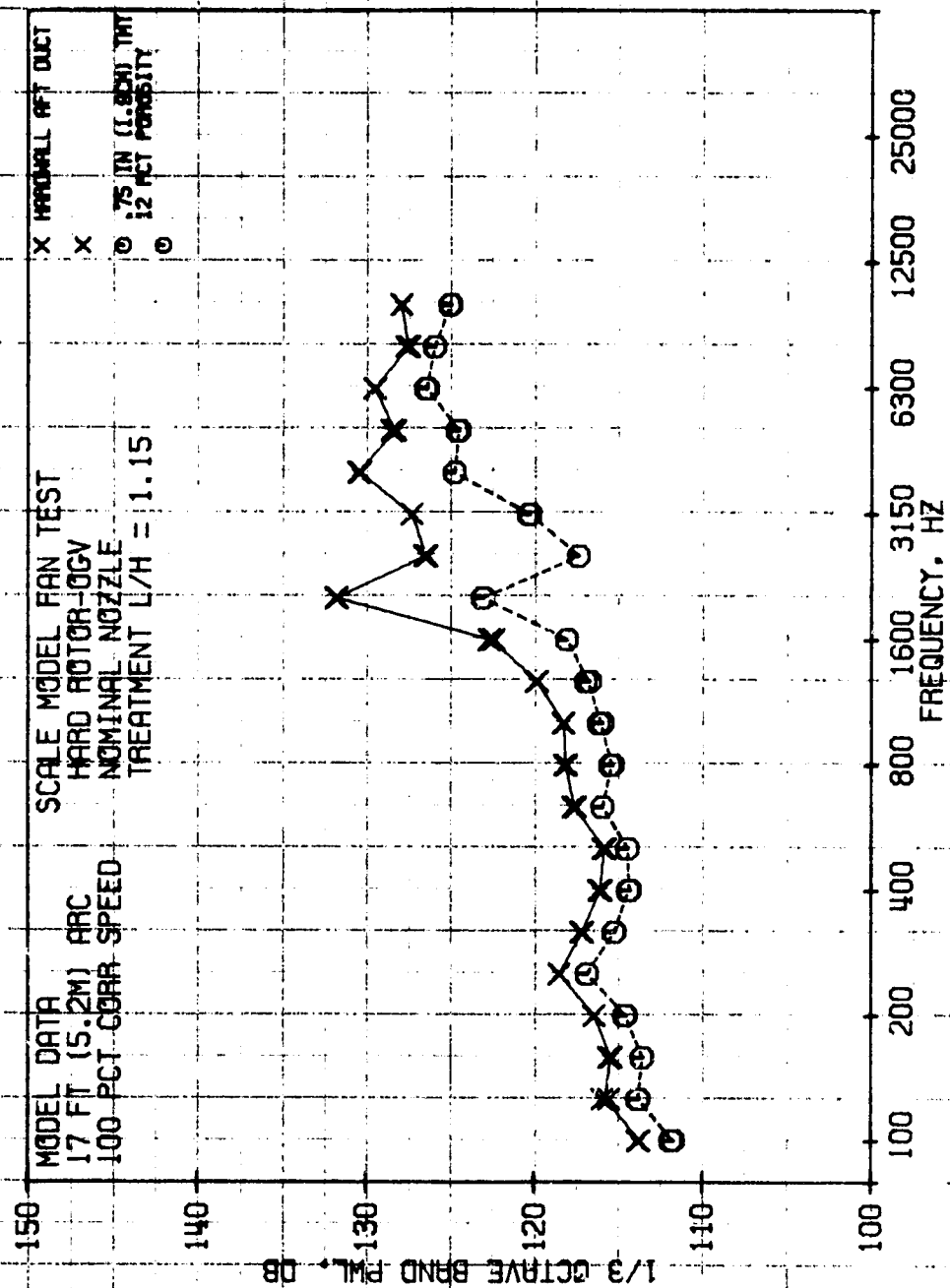


FIGURE 182

3-3

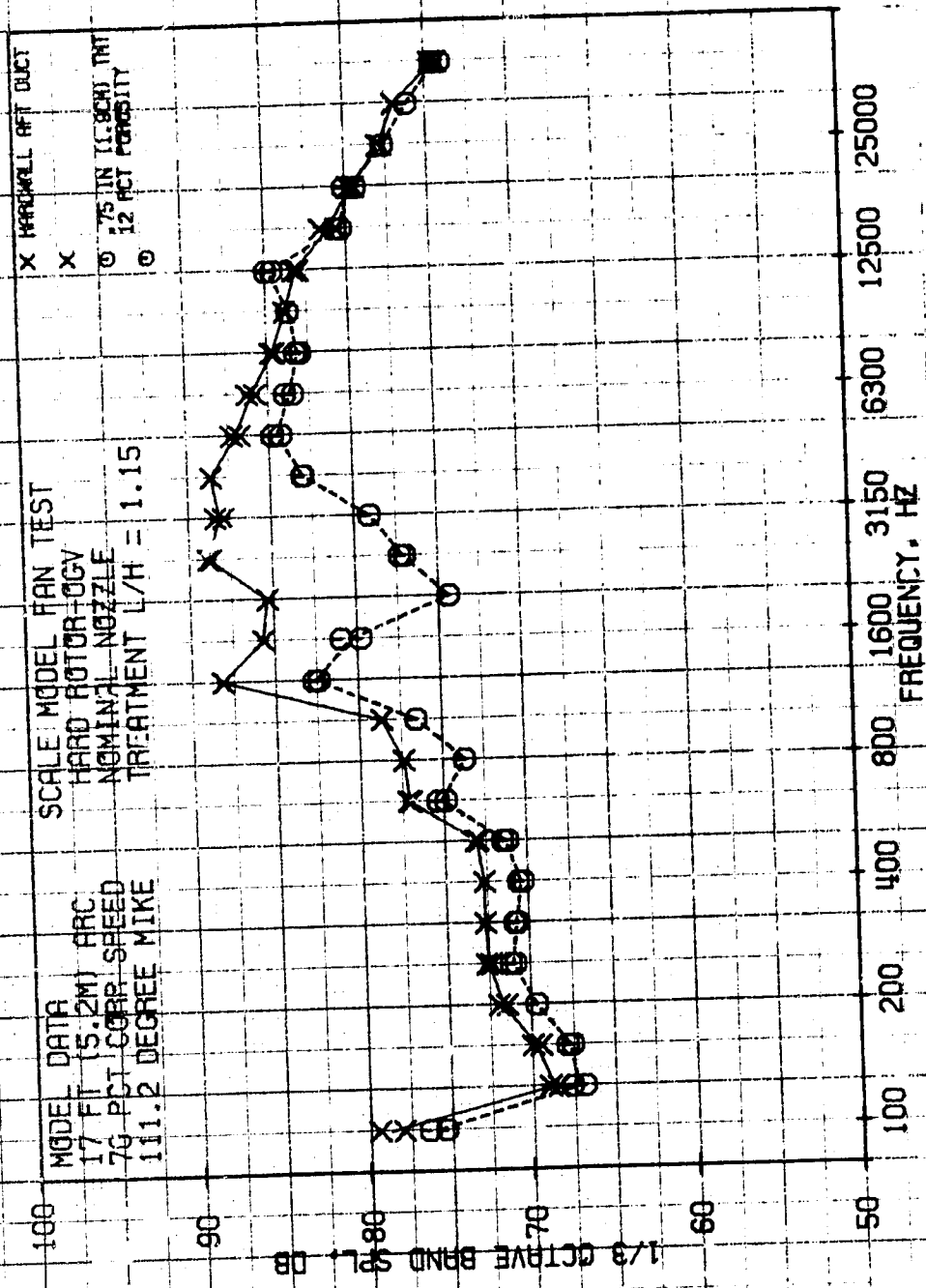


FIGURE 183

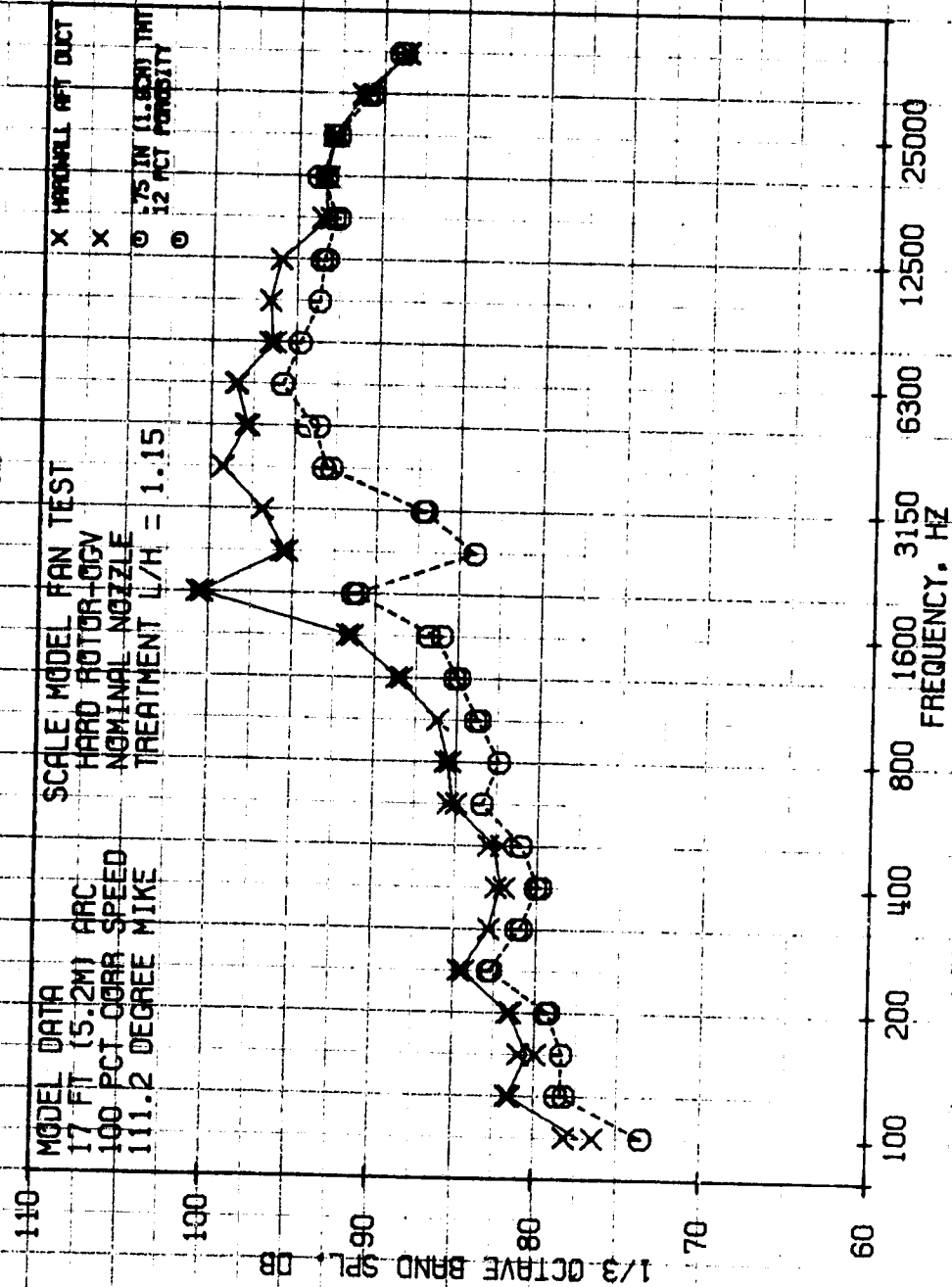


FIGURE 184

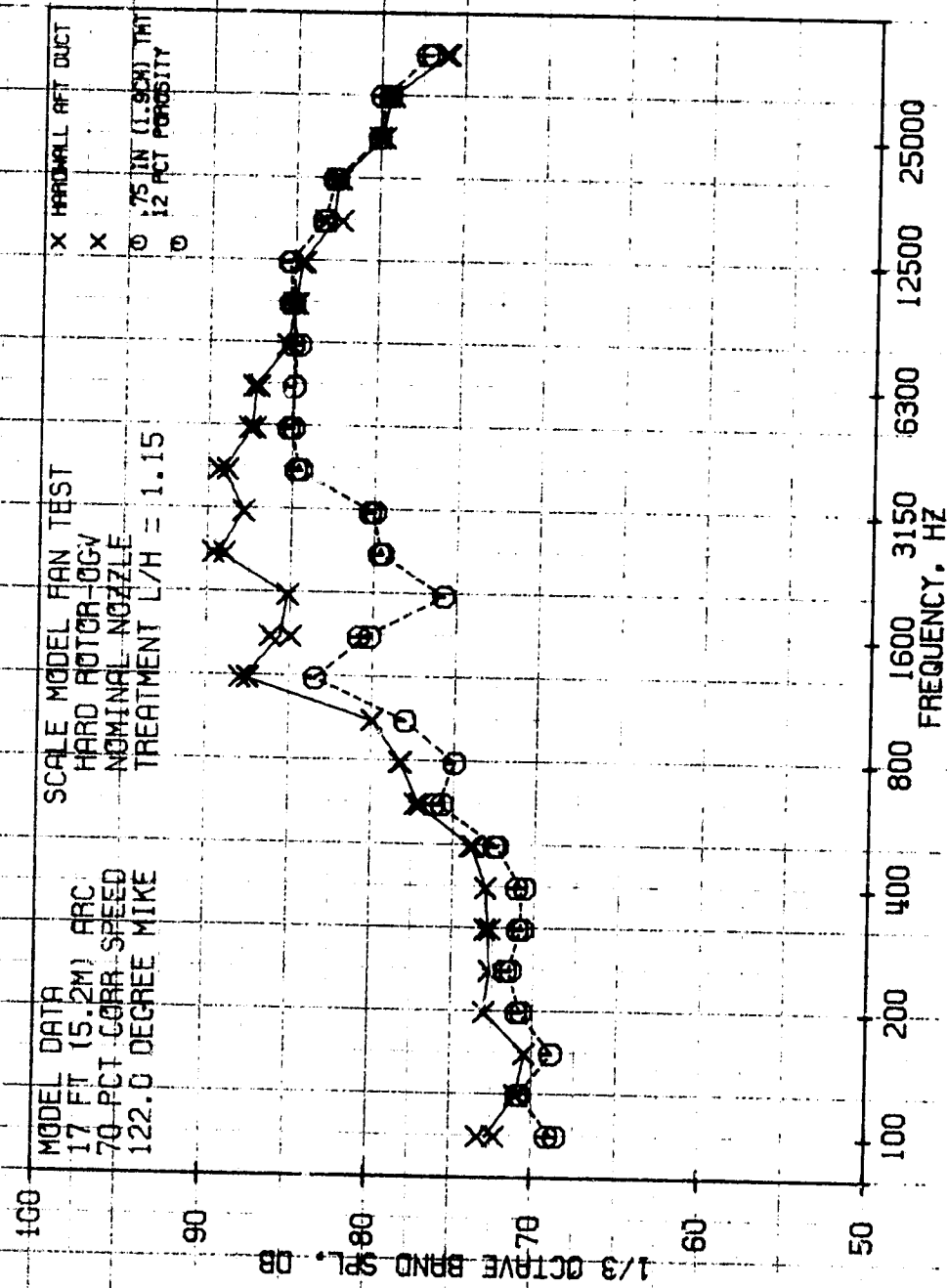


FIGURE 185



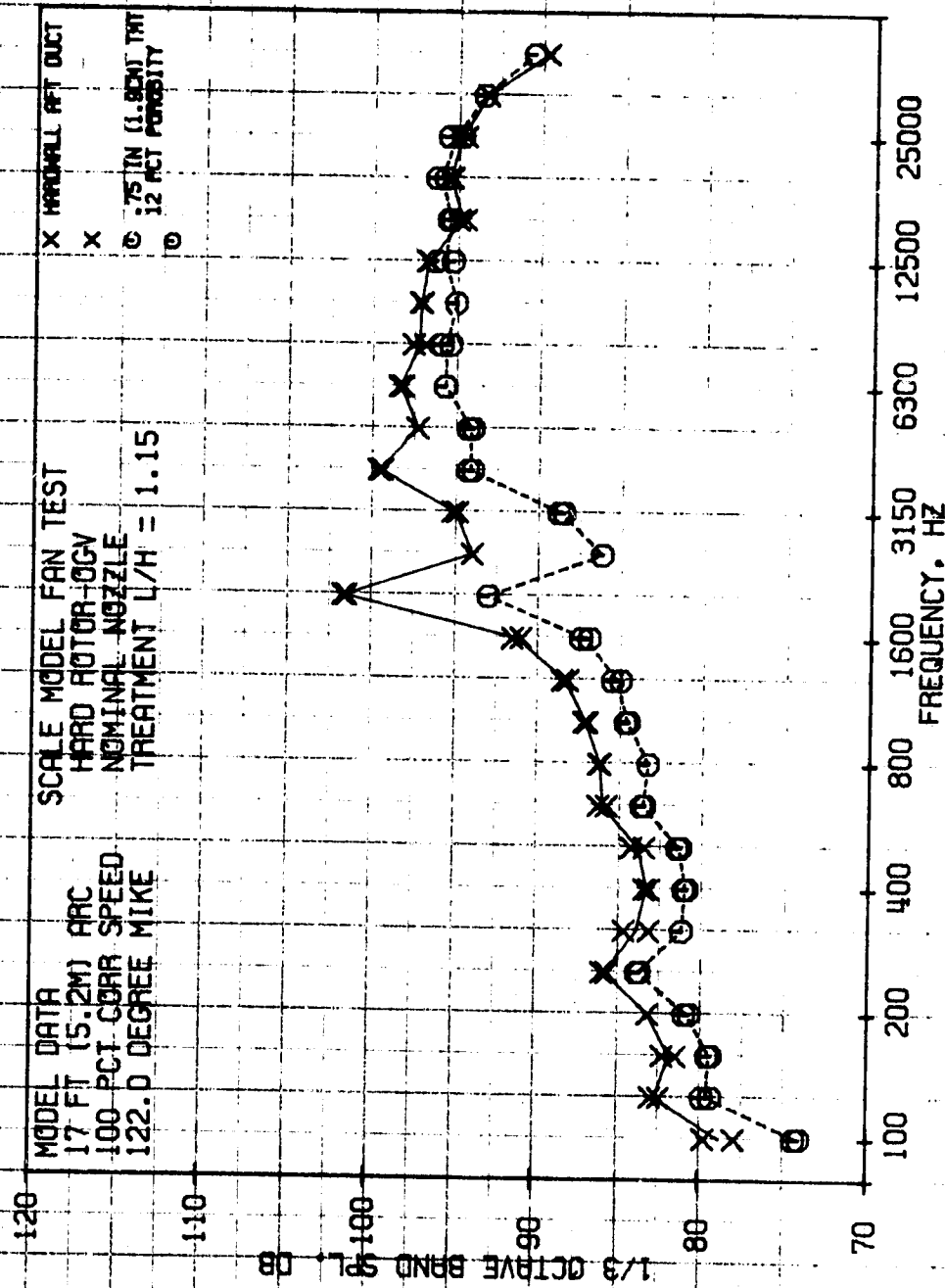
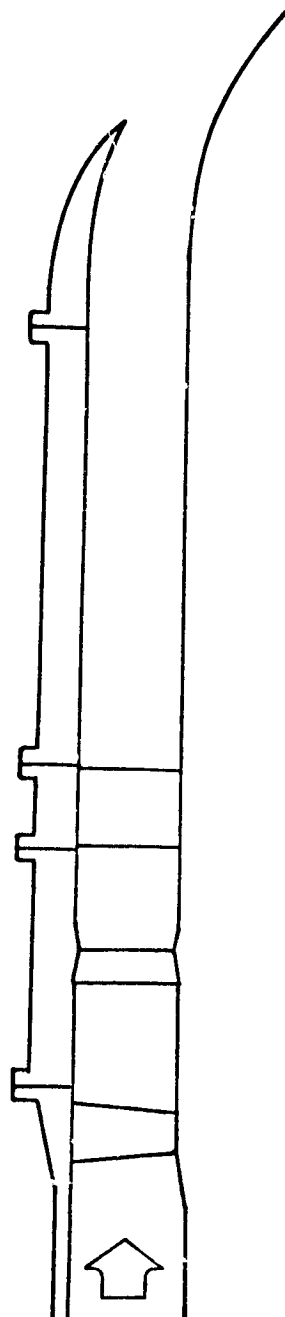


FIGURE 186

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1D, POROSITY = 12%

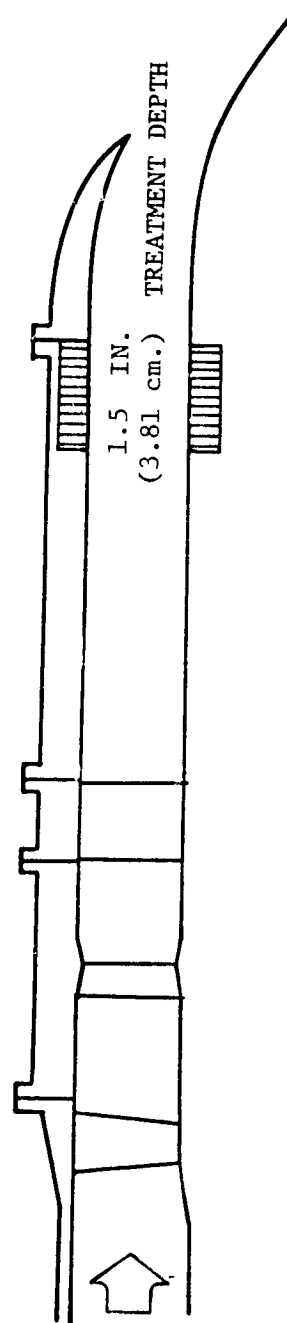


FIGURE 187.  $L/H = 1.15$ , 12 PERCENT POROSITY, 1.5 INCH (3.81 cm) CONFIGURATION

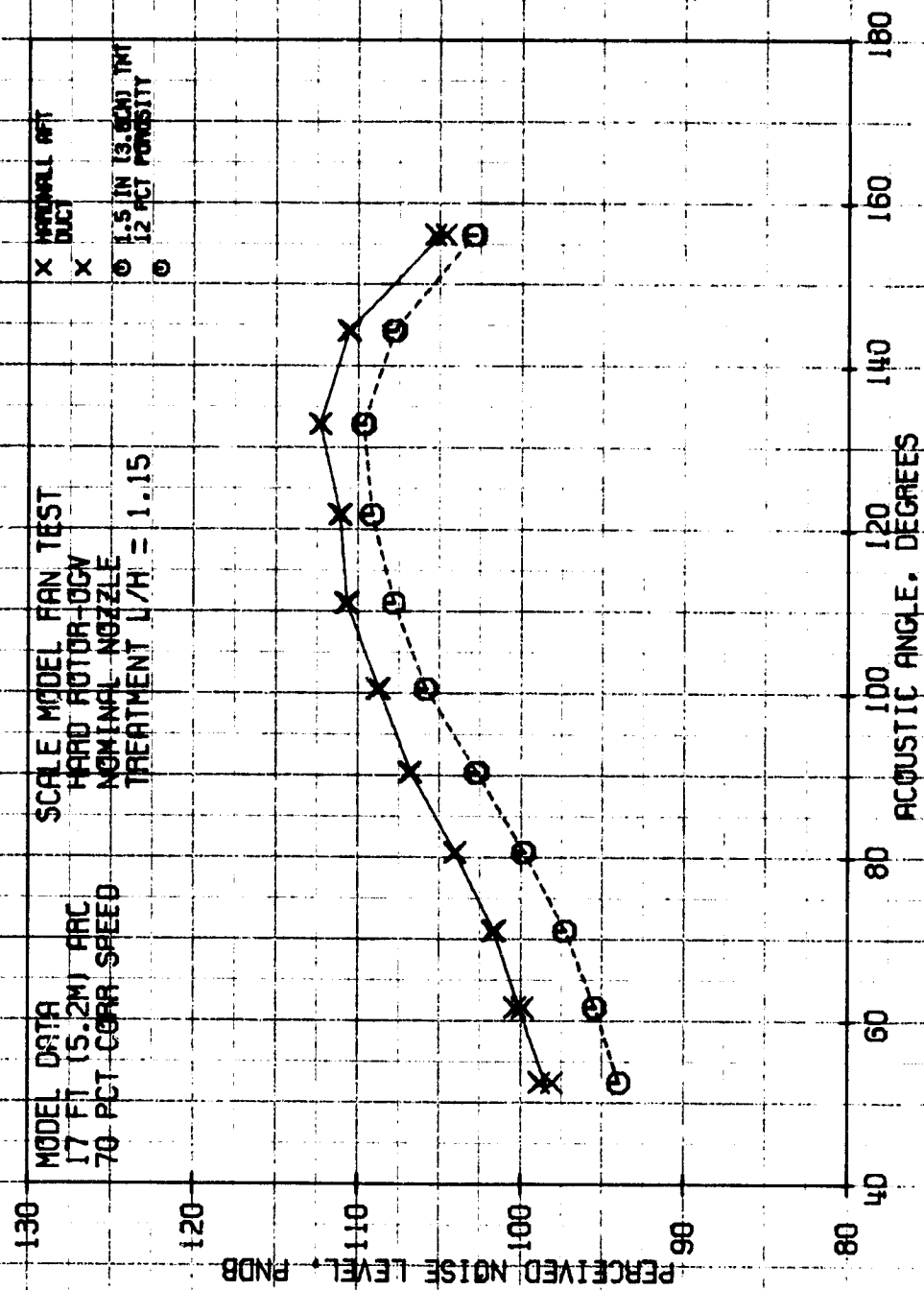


FIGURE 188

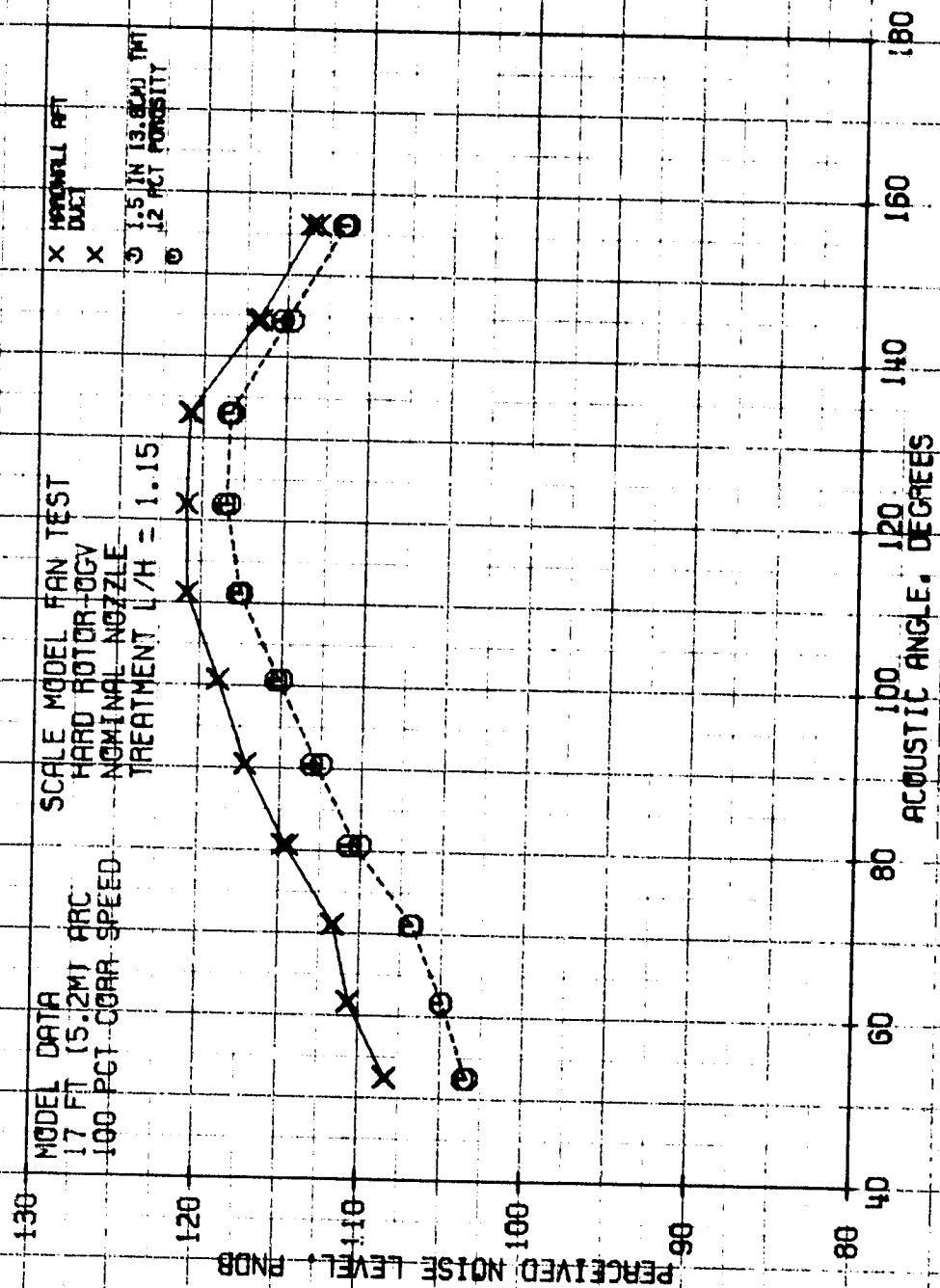


FIGURE 189

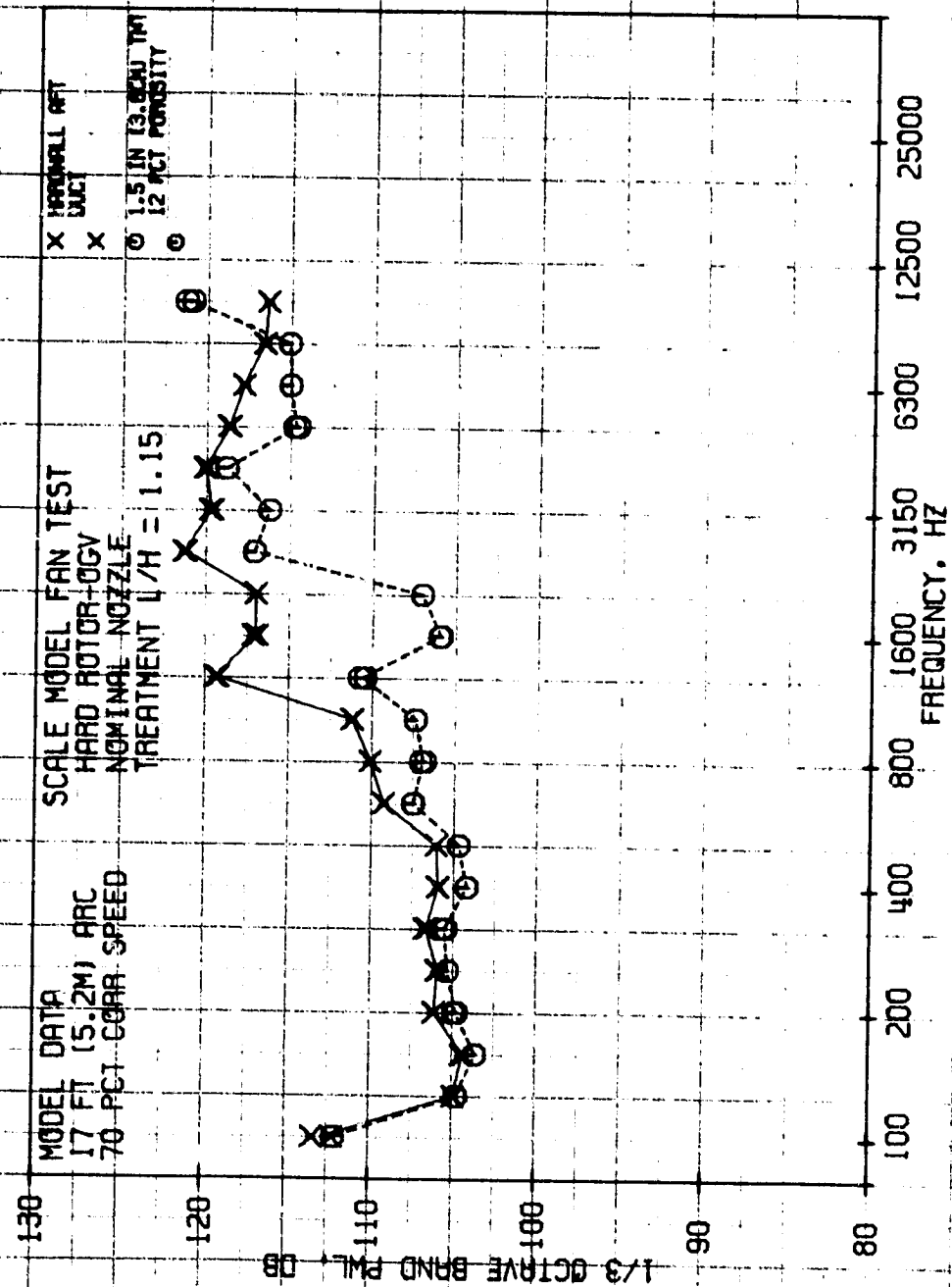


FIGURE 190

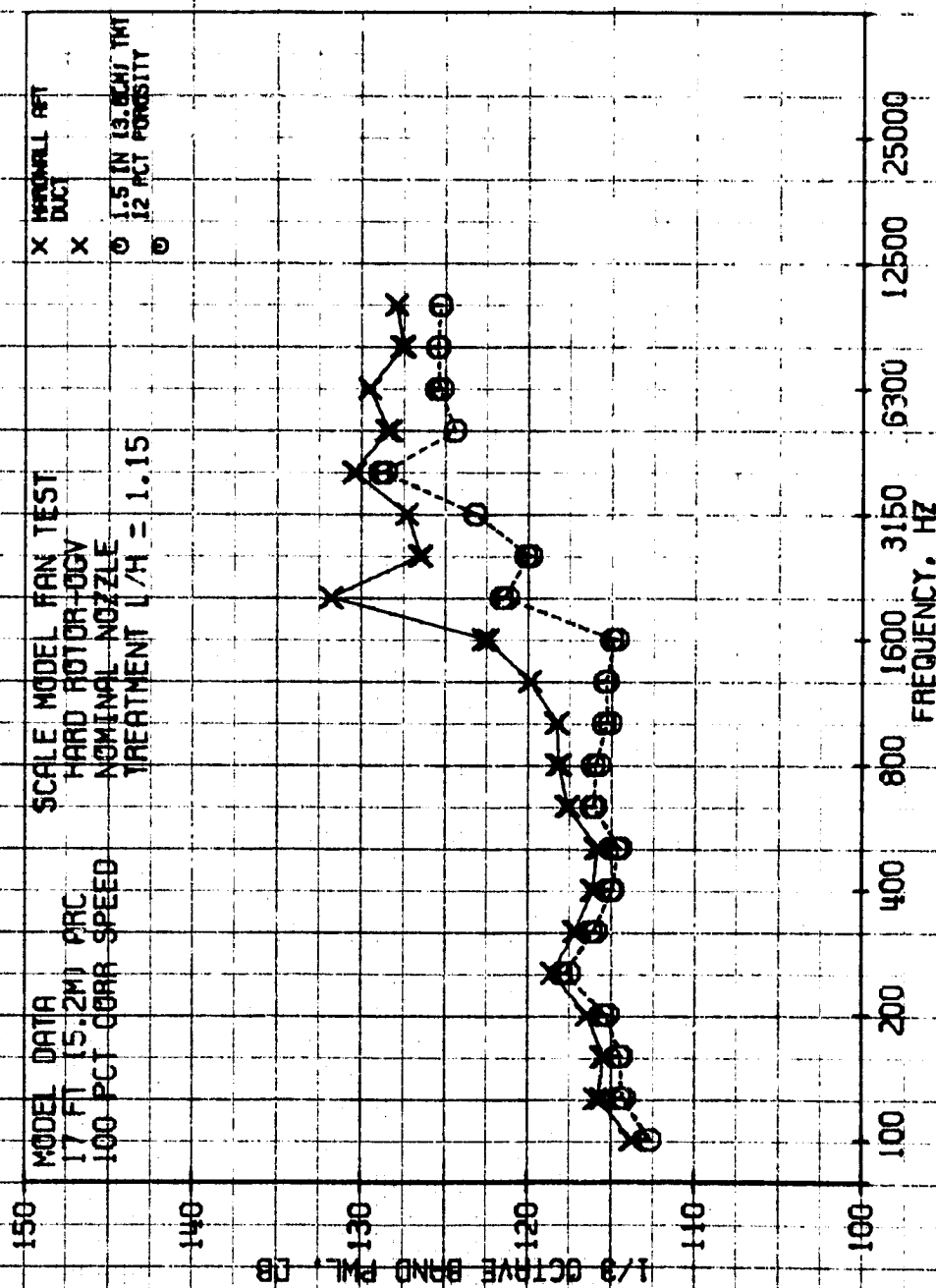


FIGURE 191

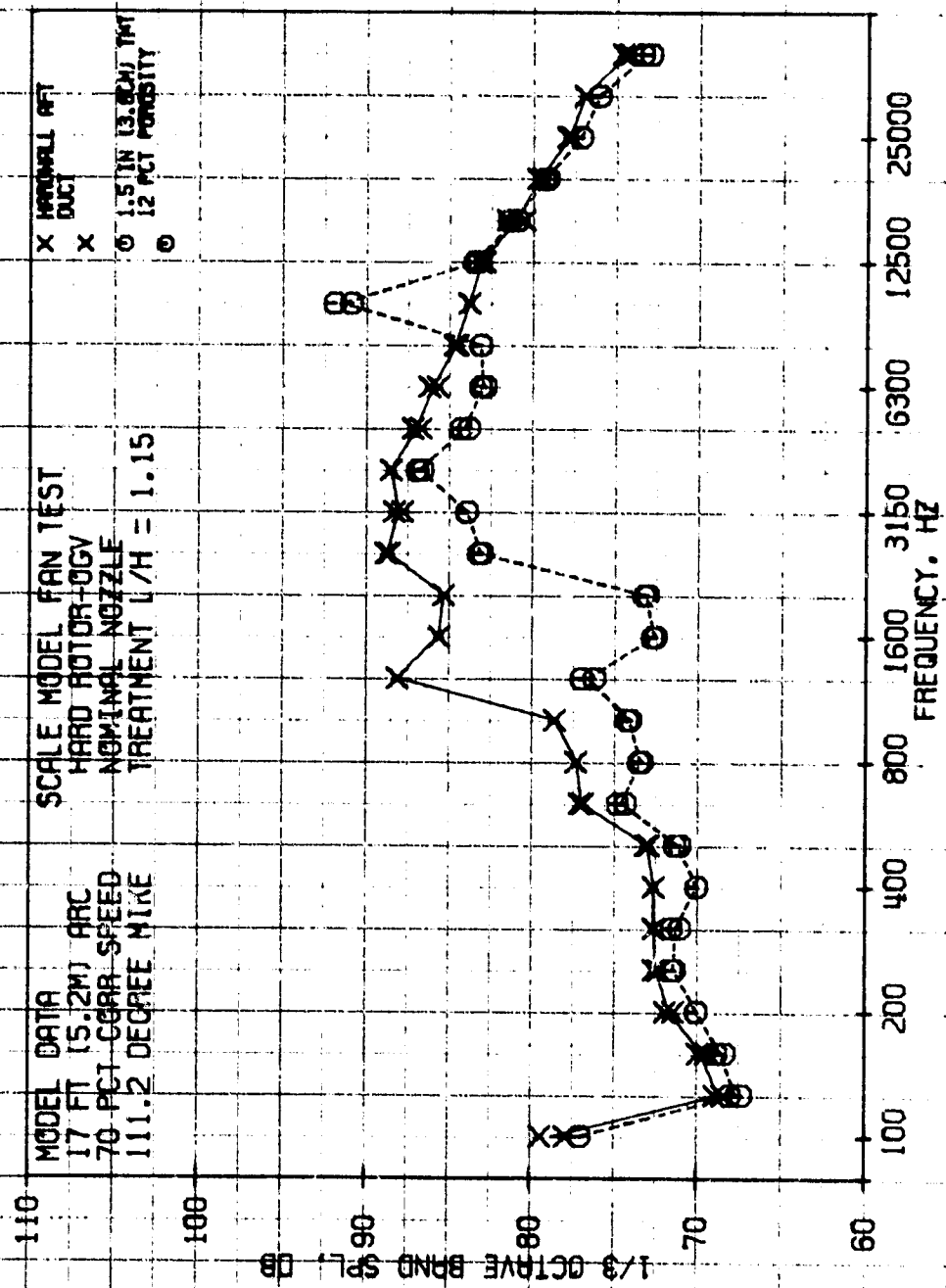


FIGURE 192

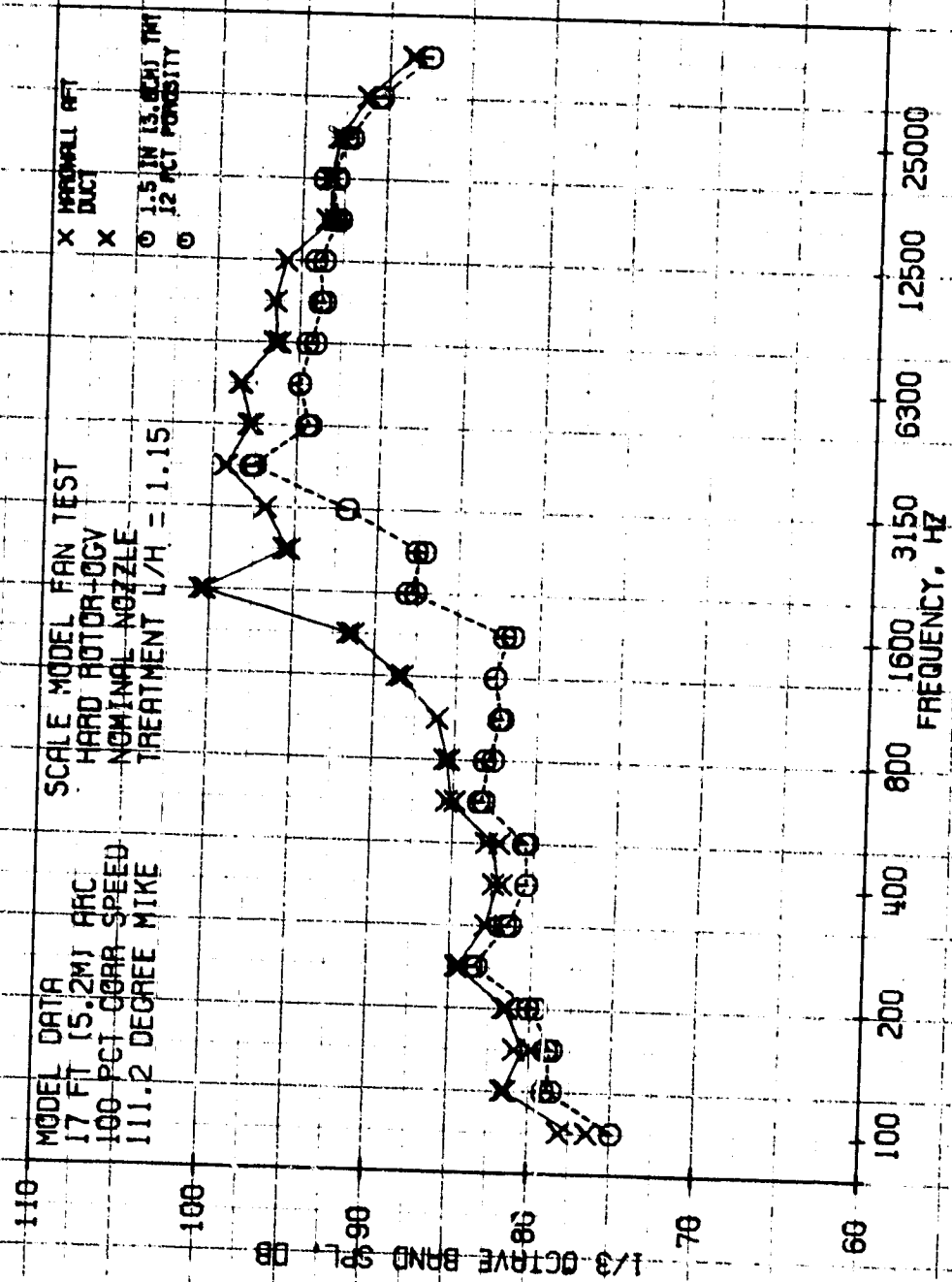


FIGURE 193



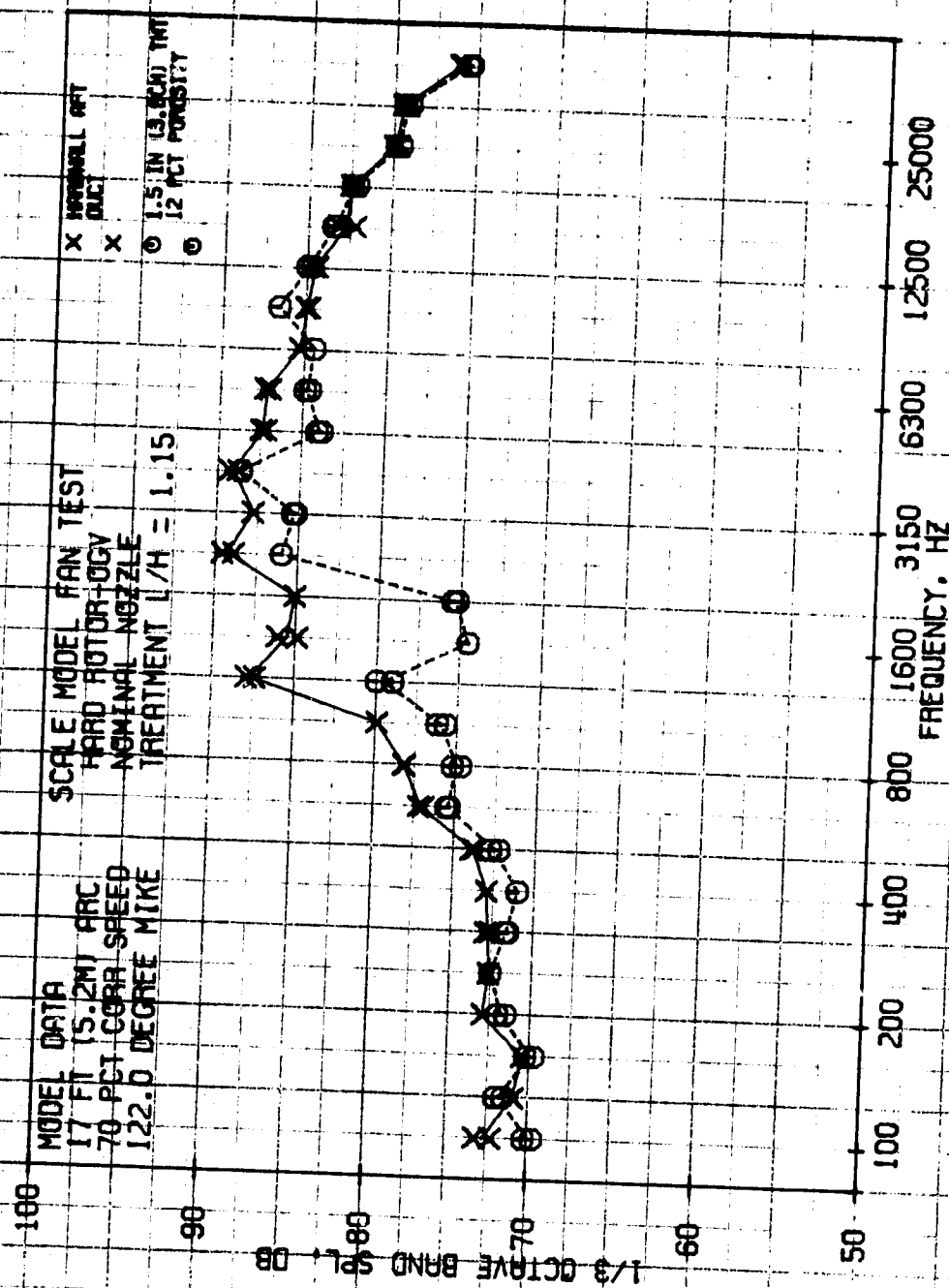


FIGURE 194

ORIGINAL PAGE IS  
OF POOR QUALITY

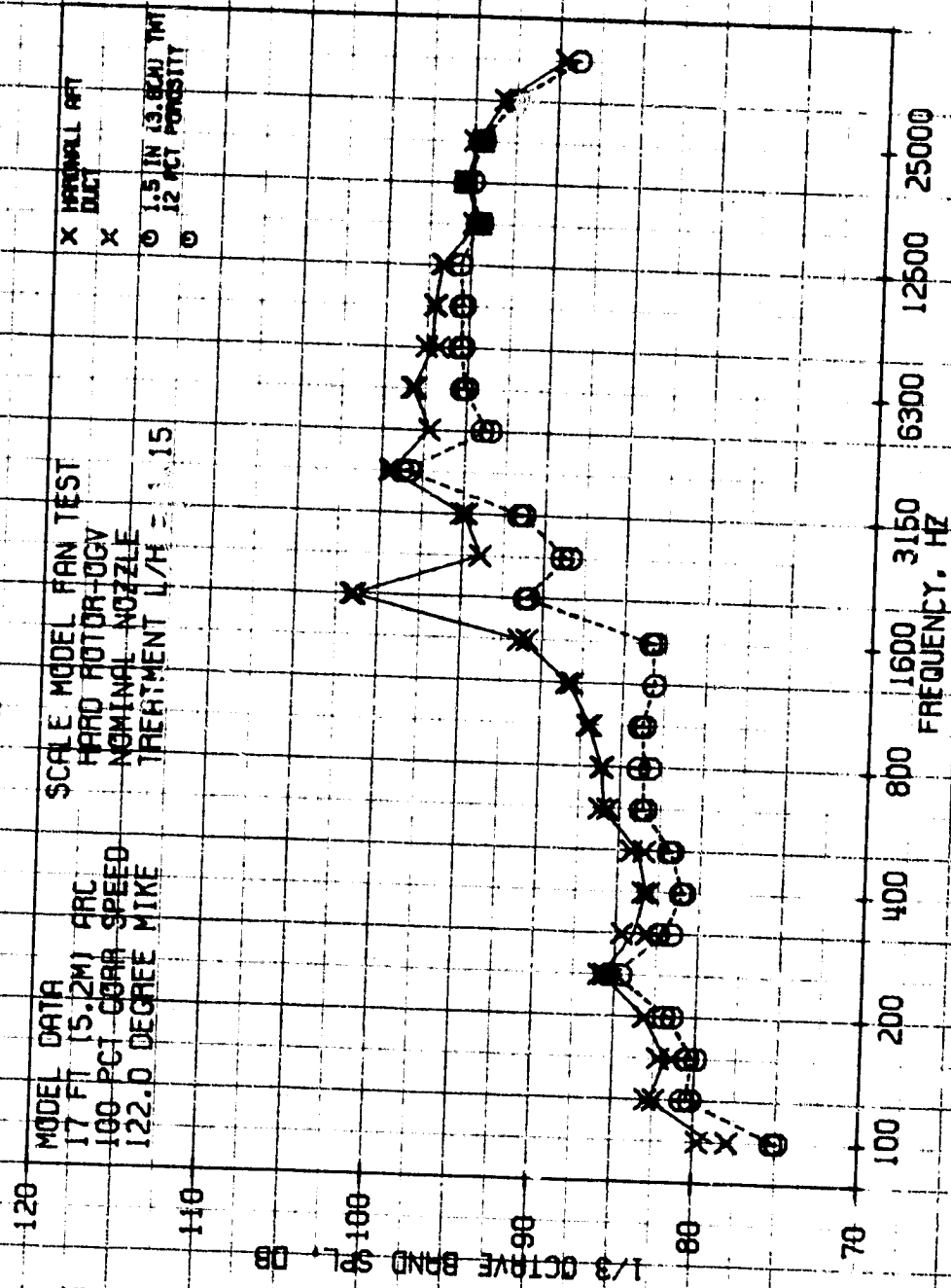
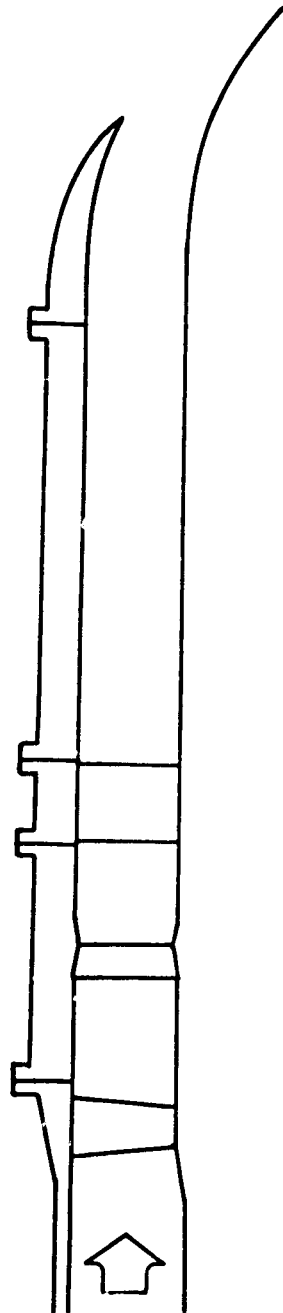
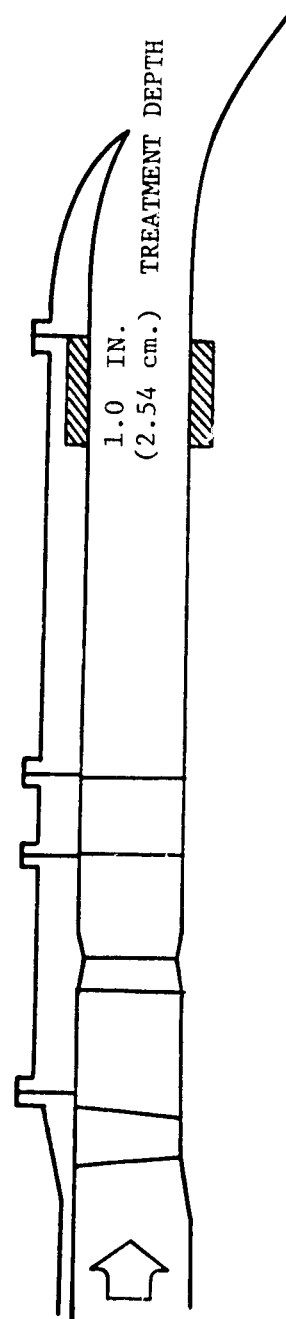


FIGURE 195

CONFIGURATION 18, HARDWALL

CONFIGURATION 75-1E, POROSITY = 27%, SLANT CELL,  
CELL DEPTH 1.5 INCHES (3.81 cm)FIGURE 196.  $L/H = 1.15$ , 27 PERCENT POROSITY, SLANT CELL CONFIGURATION

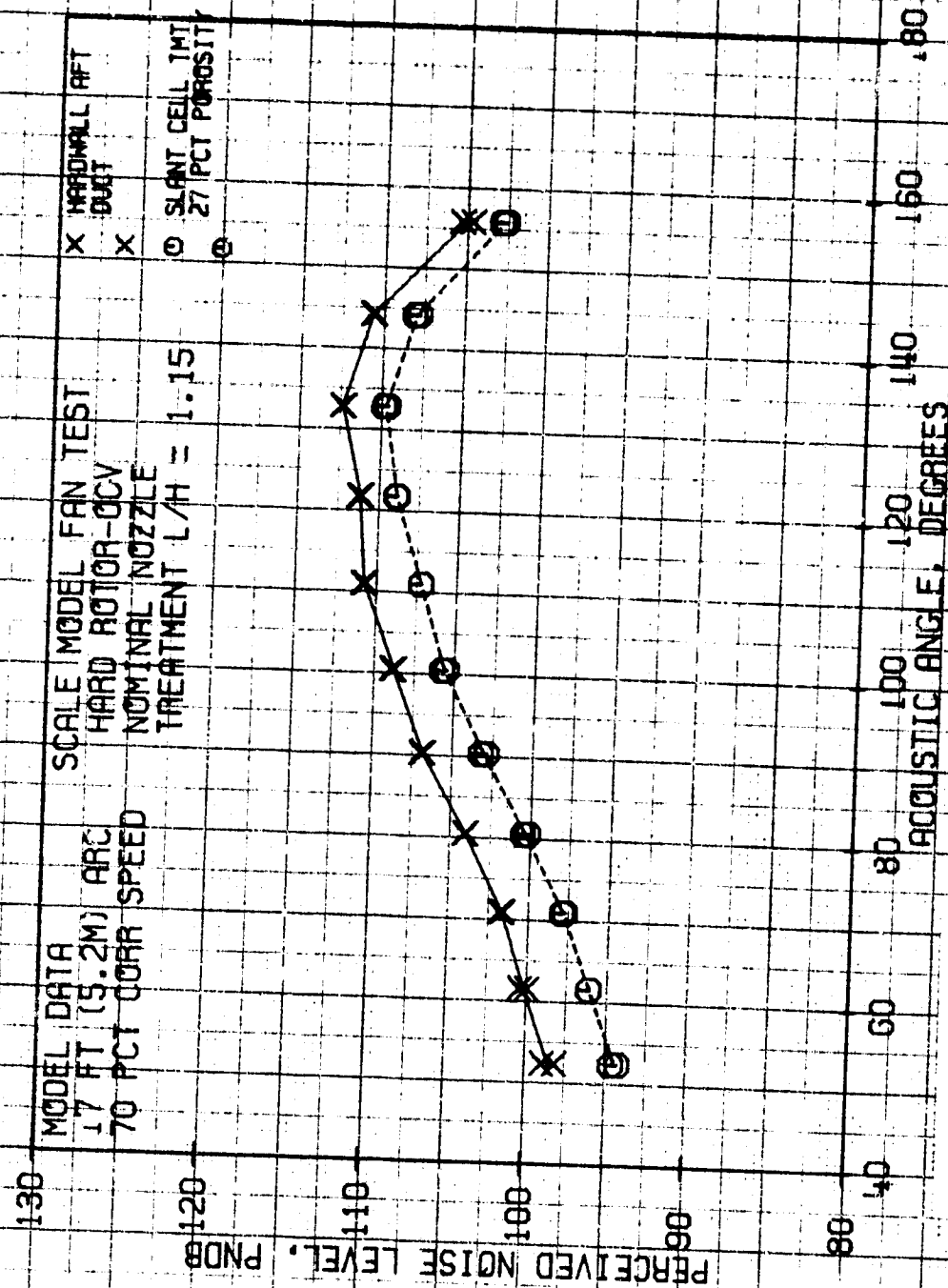


FIGURE 197

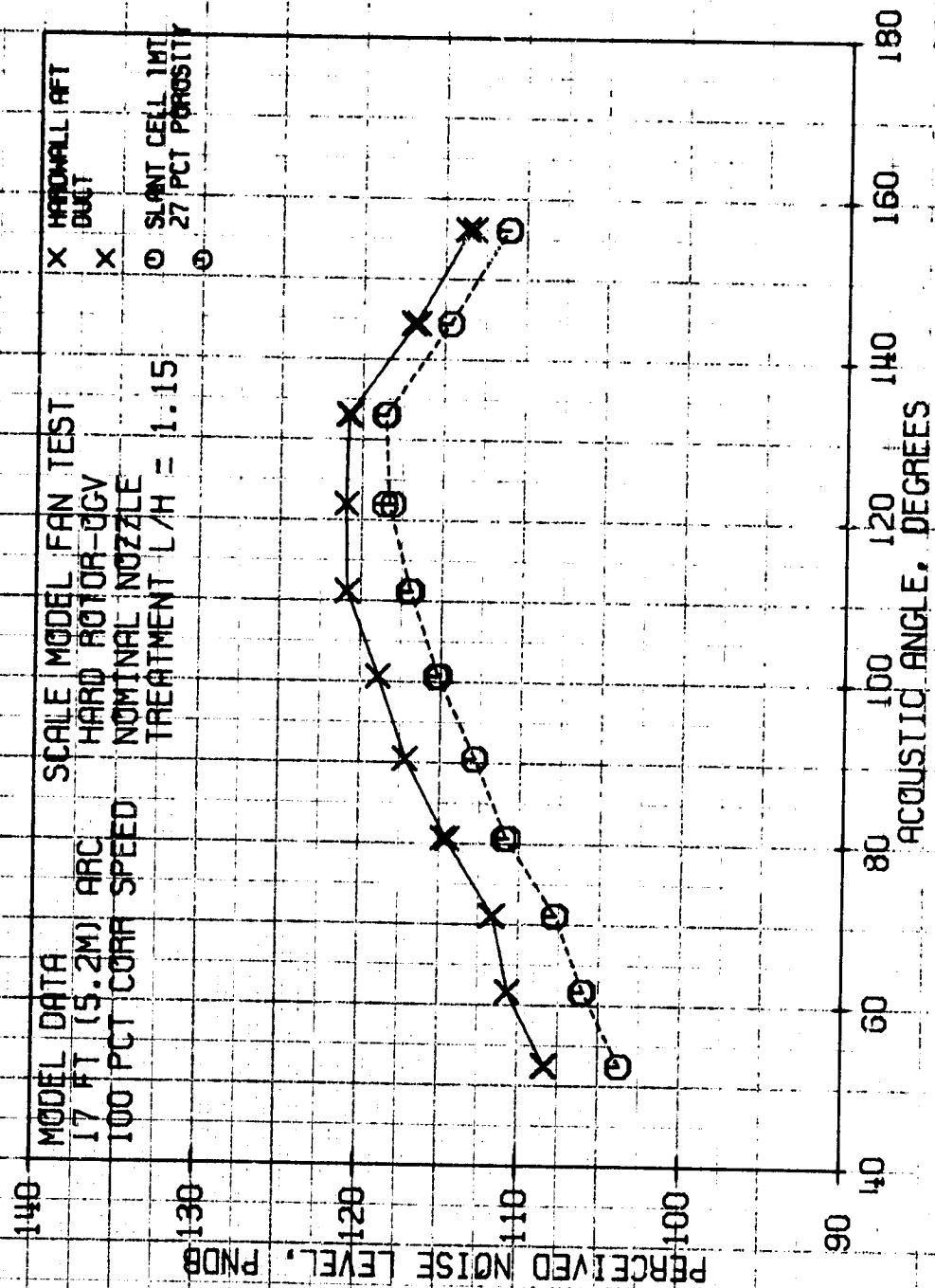


FIGURE 198

ORIGINAL PAGE IS  
UNCLASSIFIED

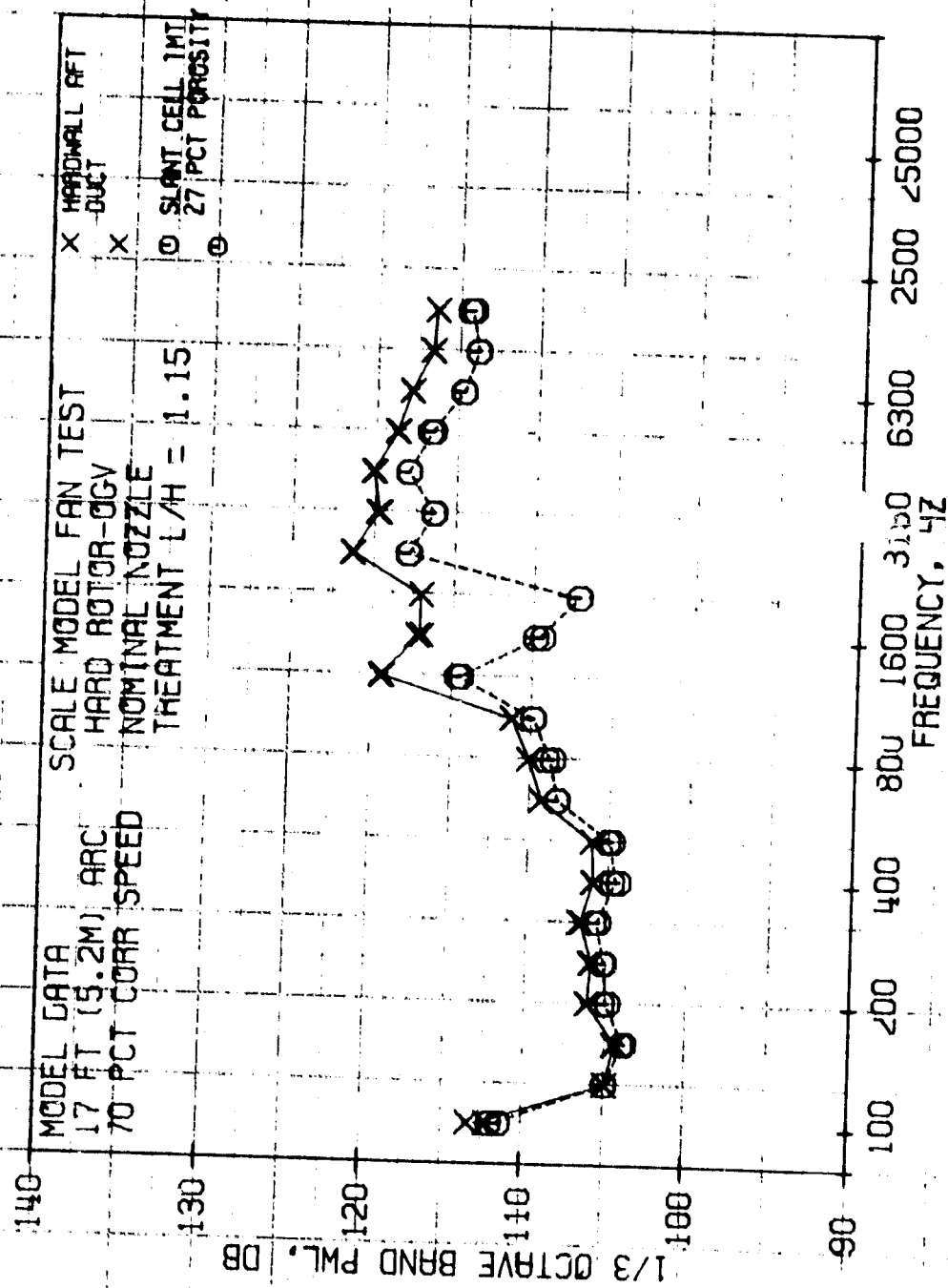


FIGURE 199

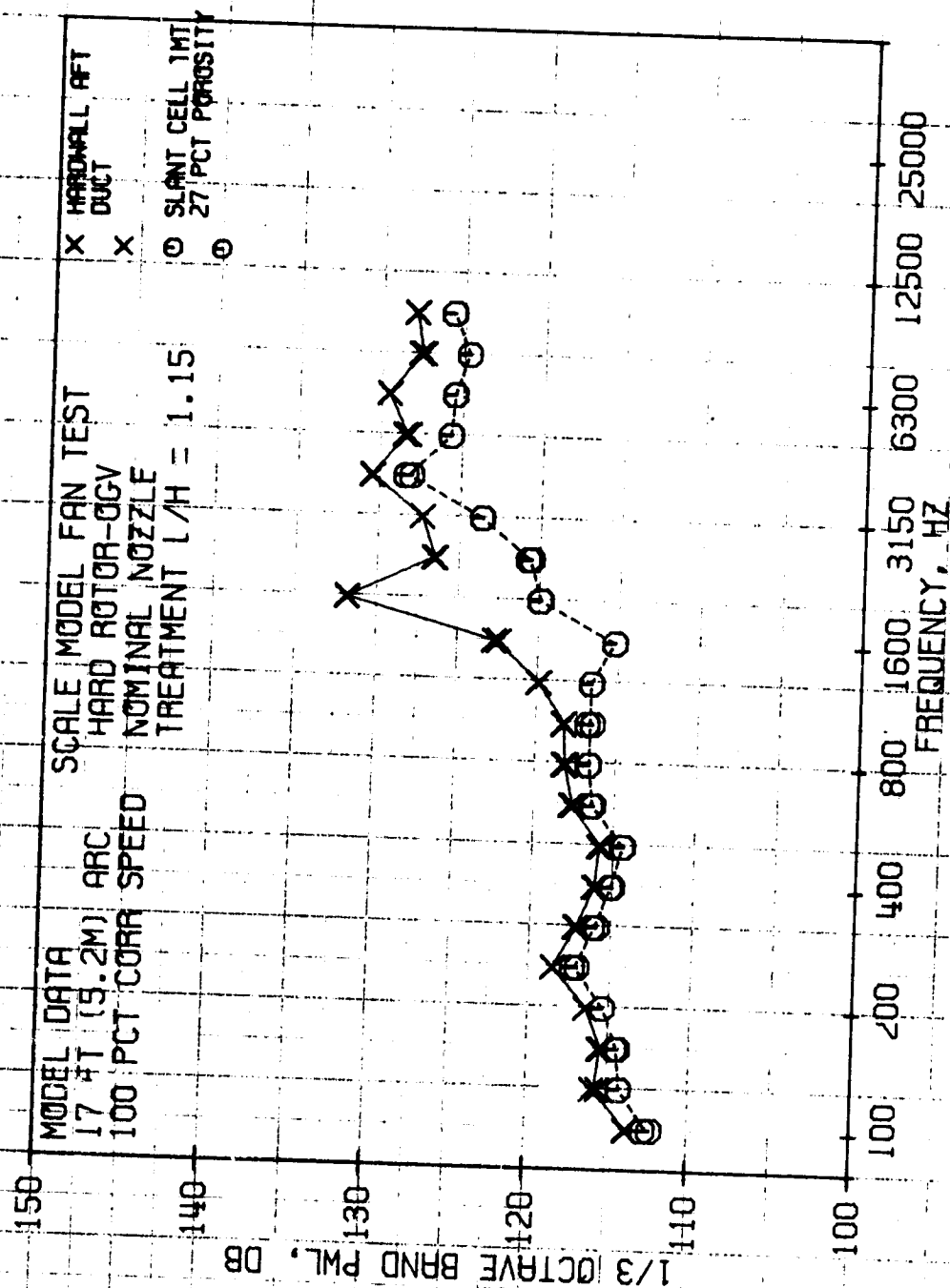


FIGURE 200

ORIGINAL PAGE IS  
OF POOR QUALITY

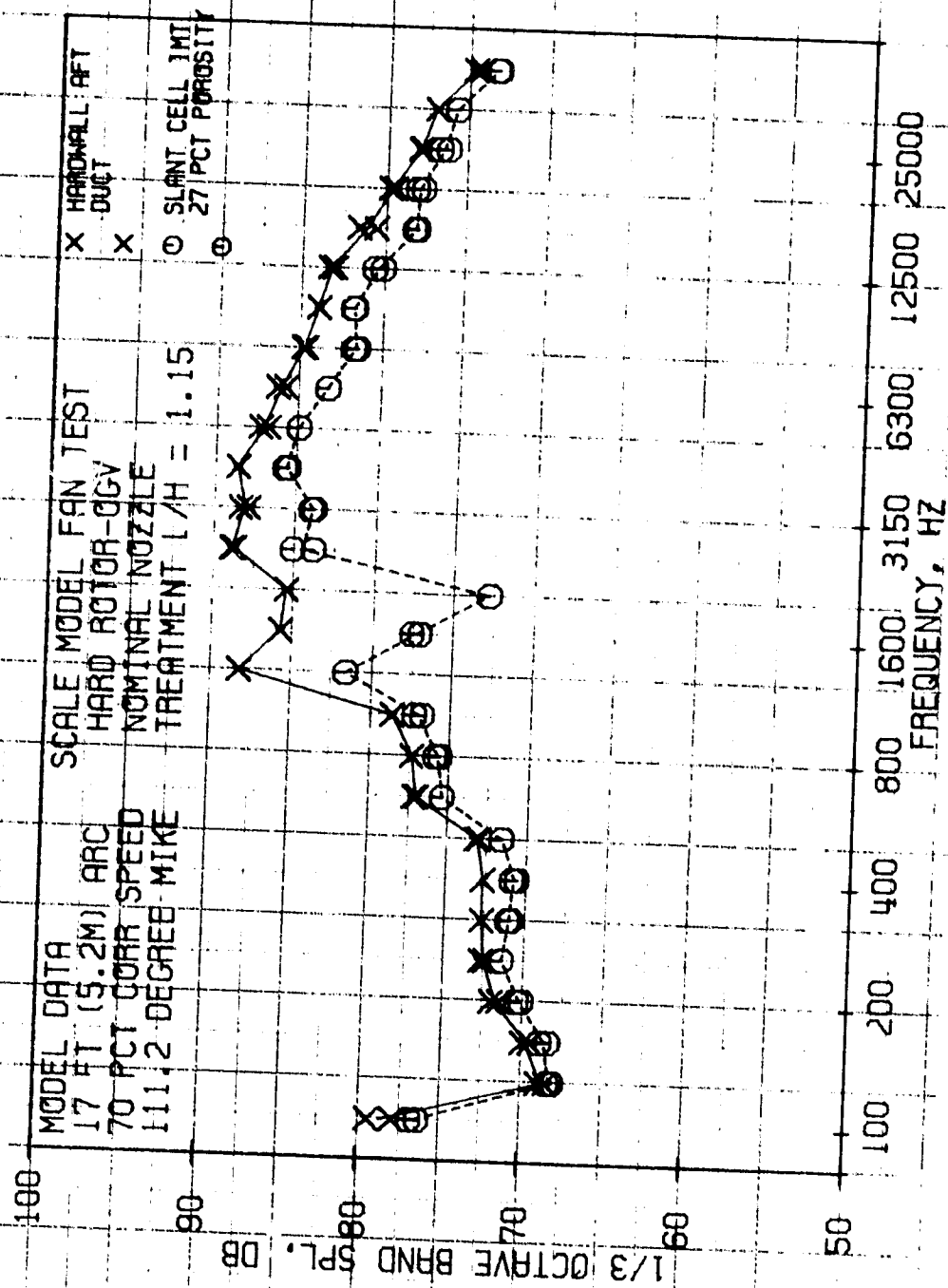


FIGURE 201



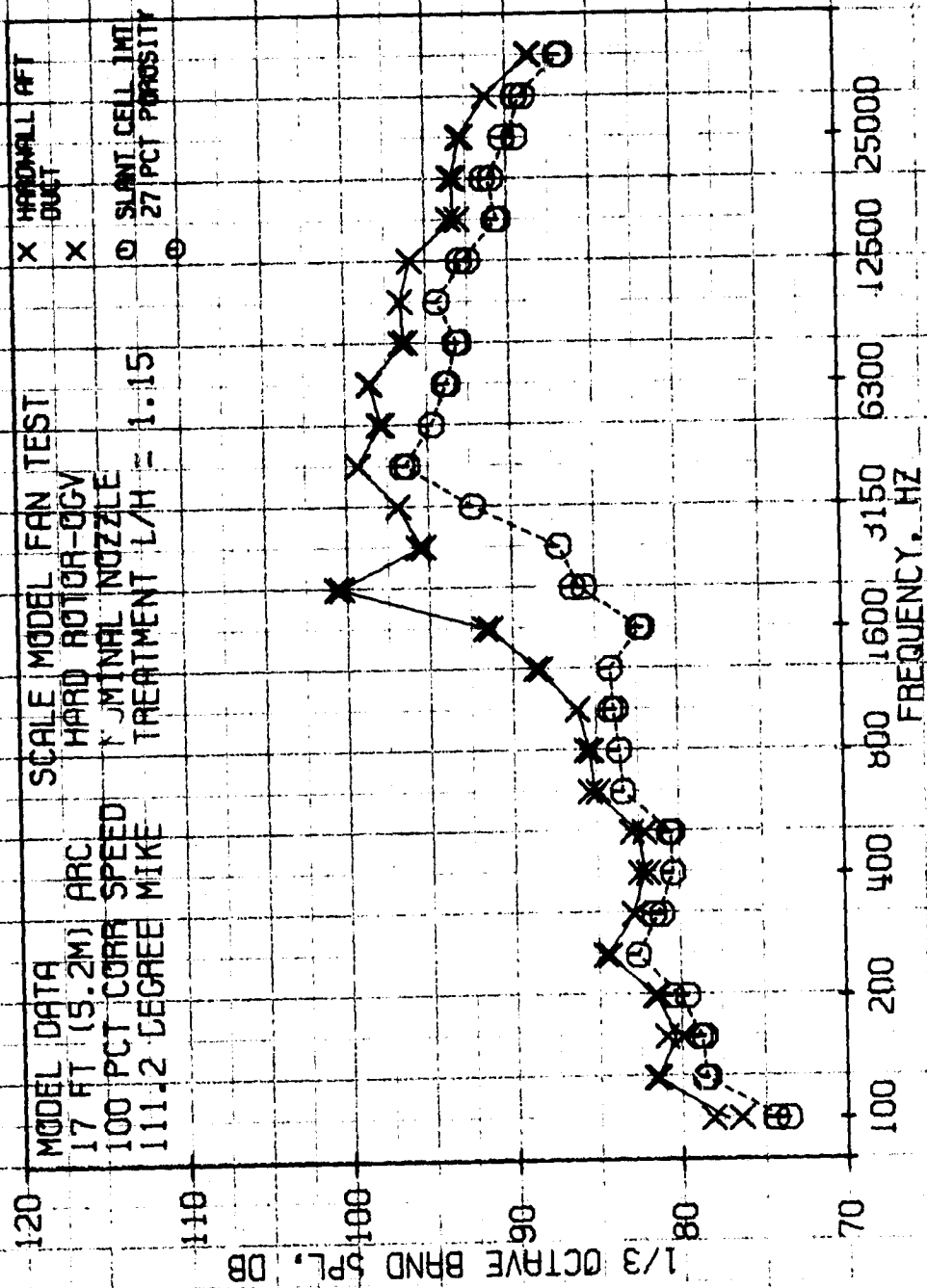


FIGURE 202

ORIGINAL PAGE IS  
OF POOR QUALITY

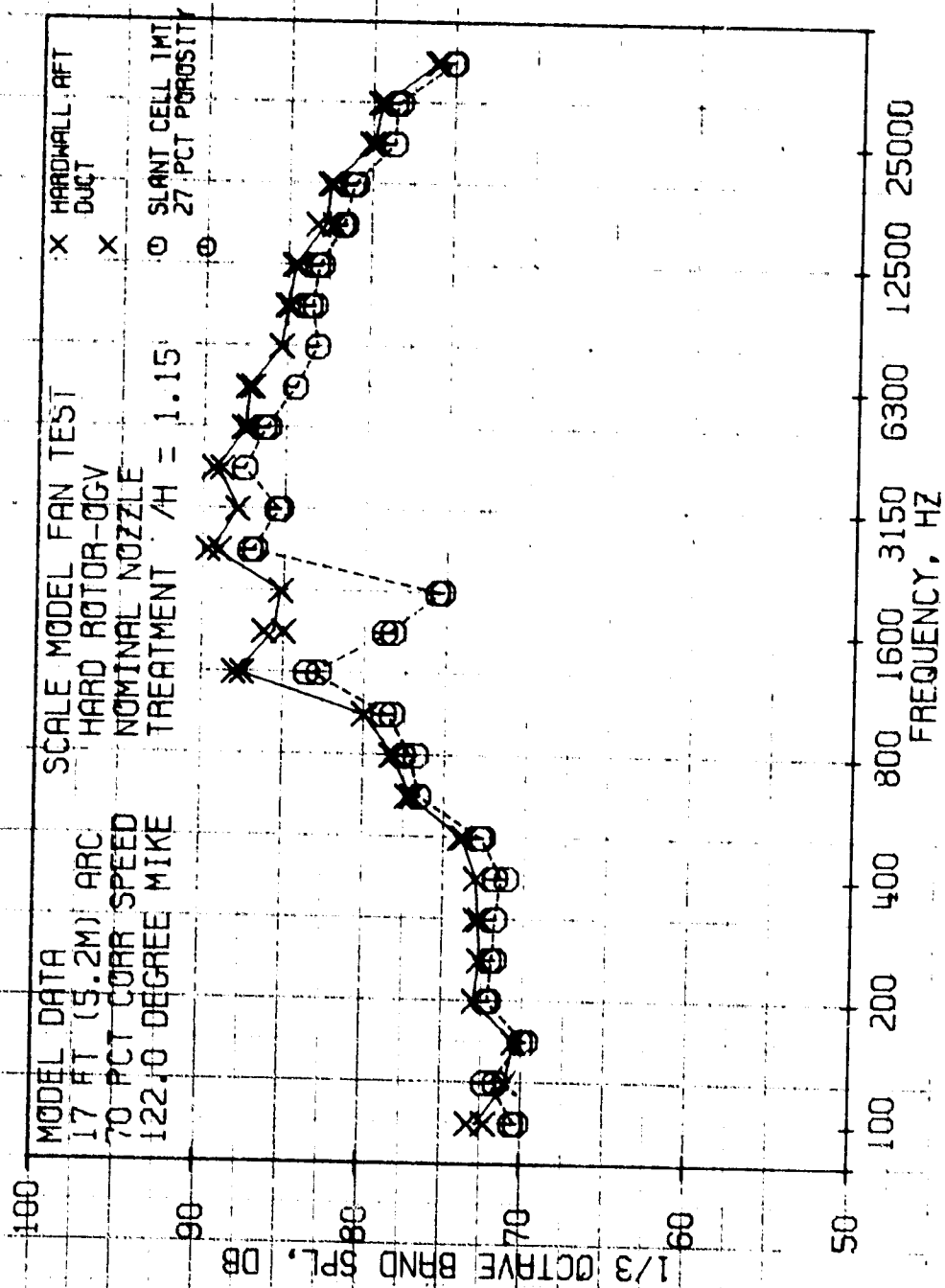


FIGURE 203

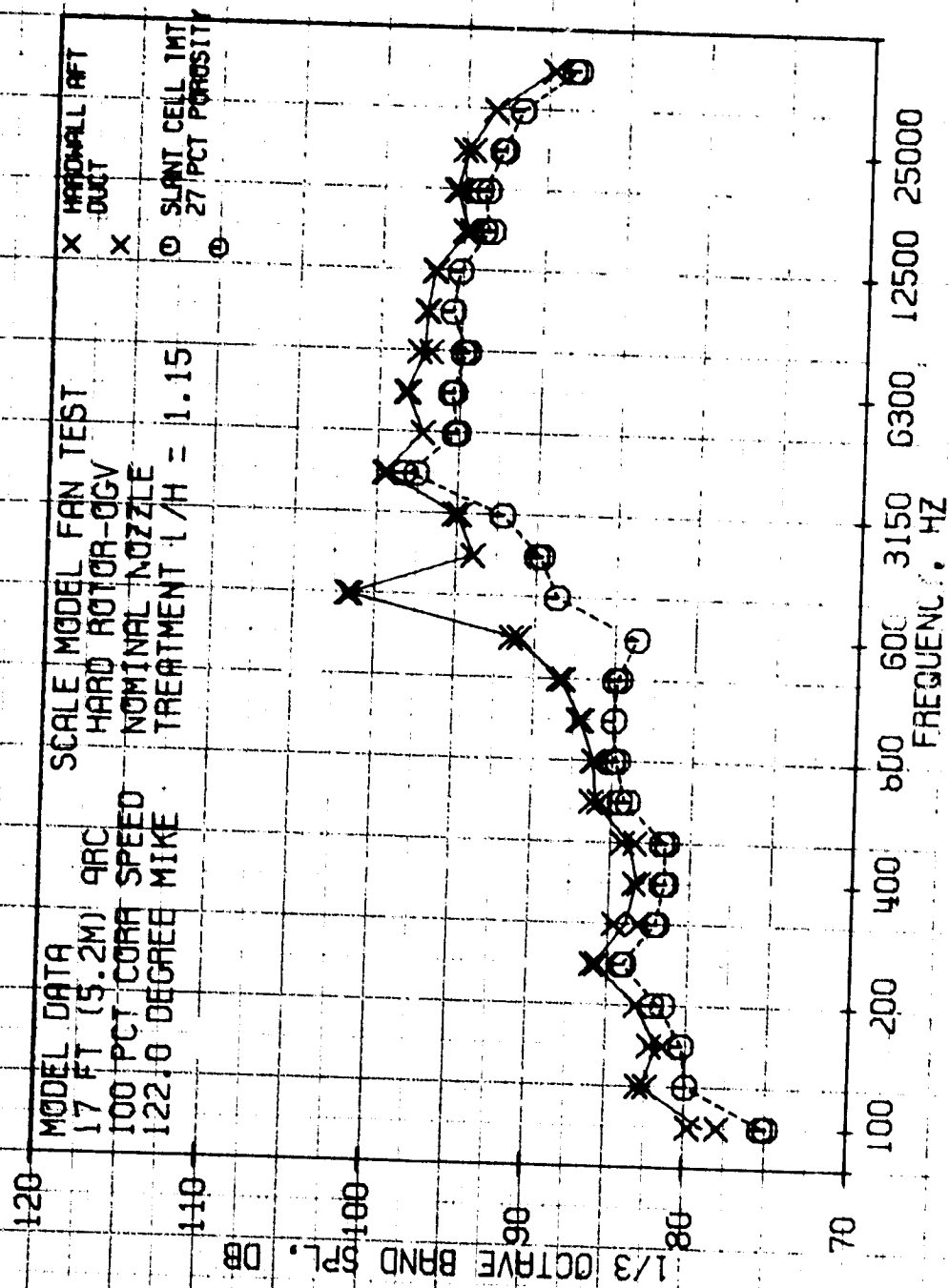
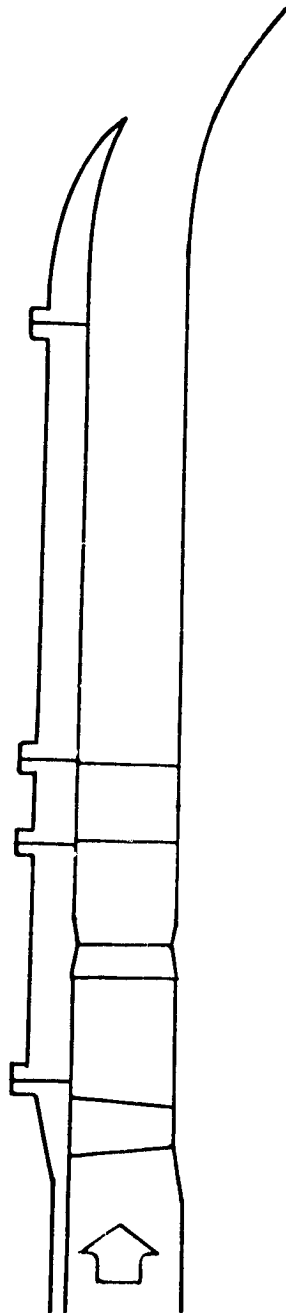


FIGURE 204

CONFIGURATION 18, HARDWALL 11-22-74



CONFIGURATION 75-1F, HARDWALL 1-17-75

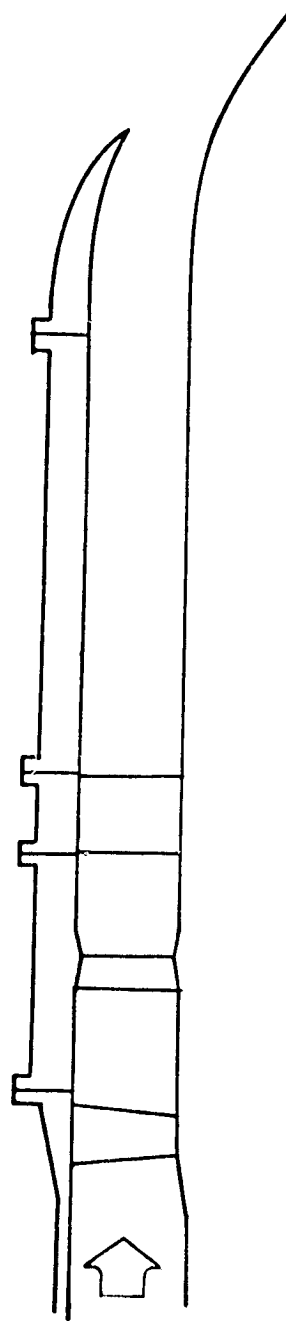


FIGURE 205. RERUN OF HARDWALL CONFIGURATIONS

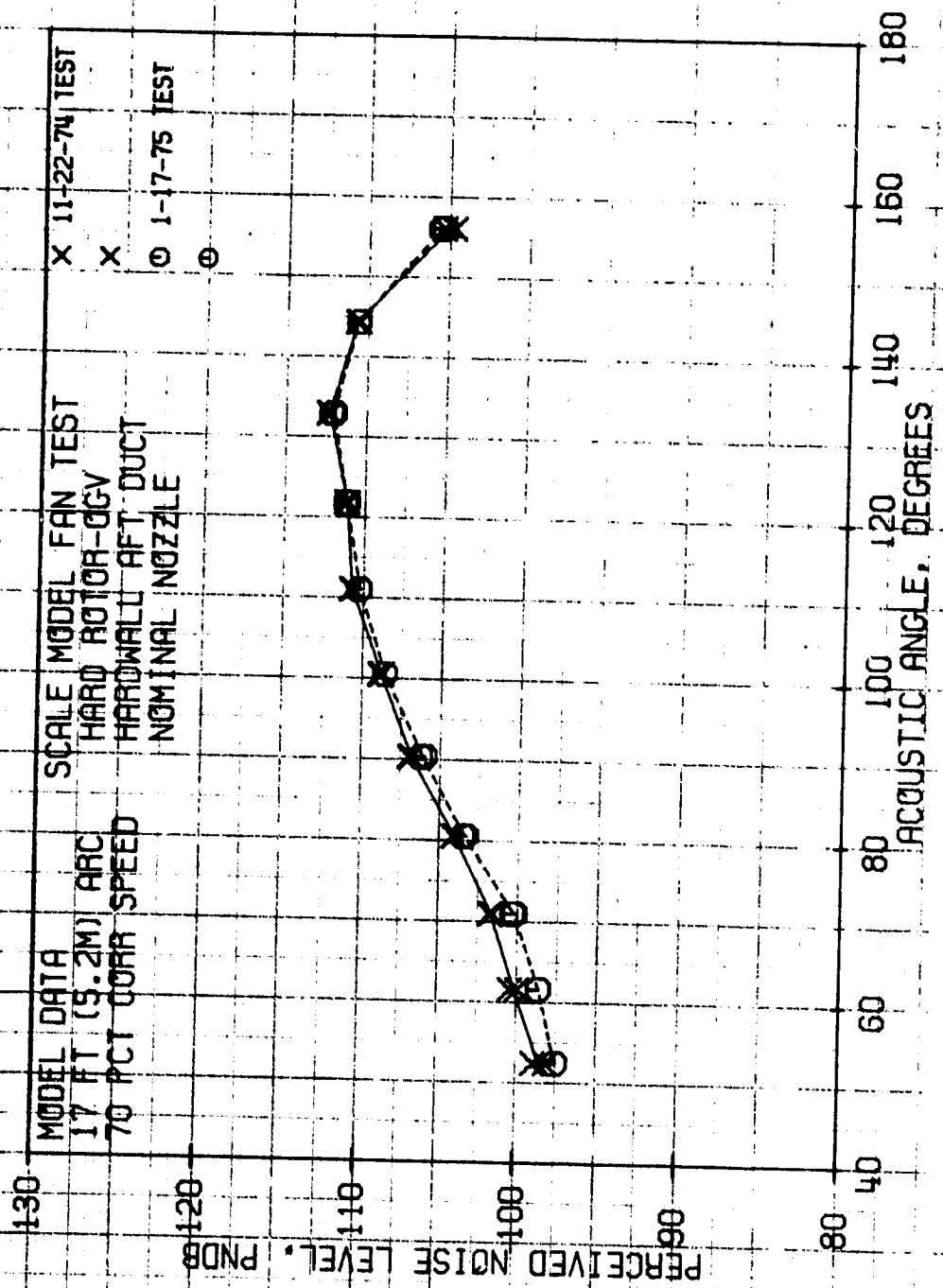


FIGURE 206

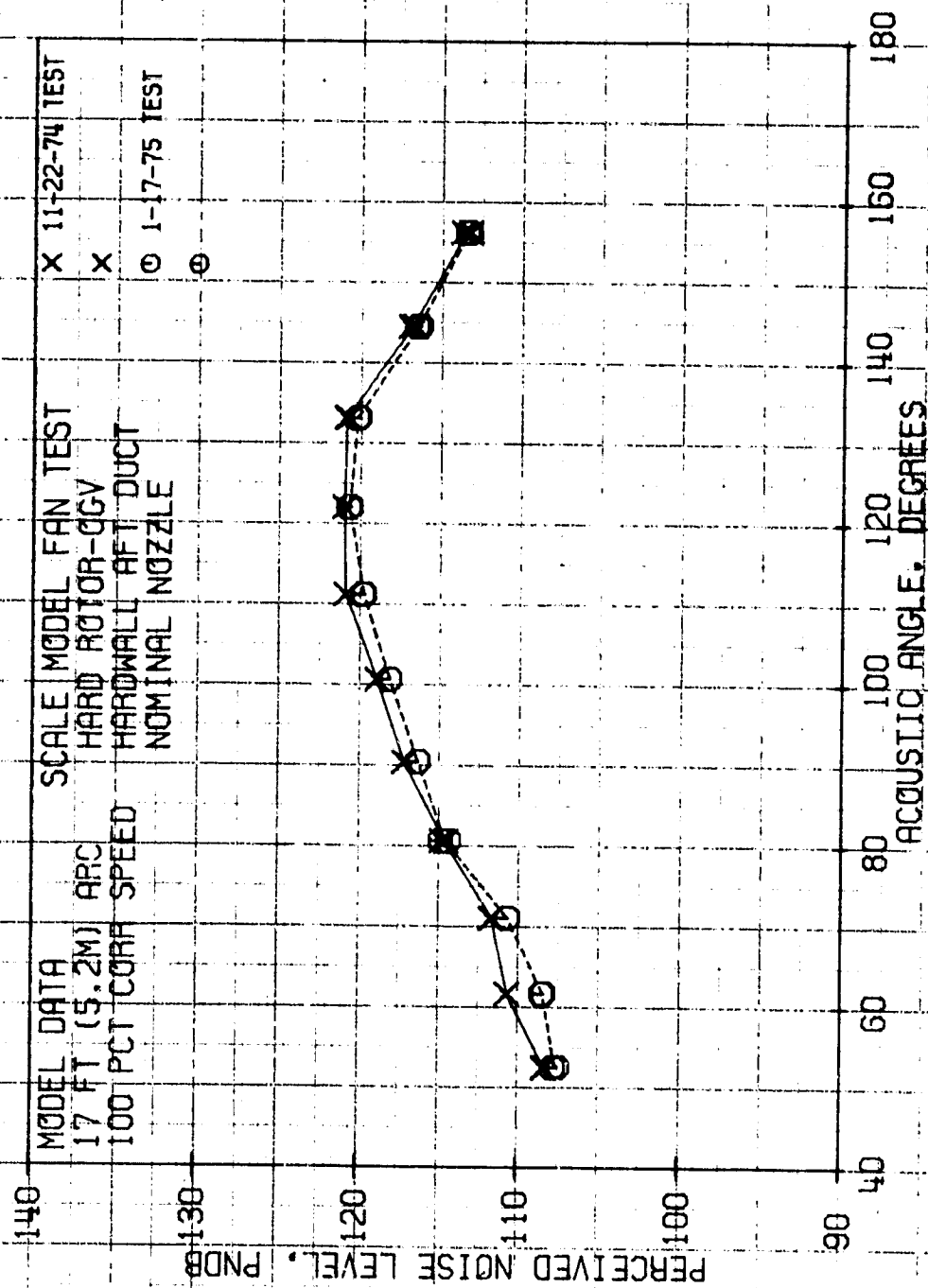


FIGURE 207

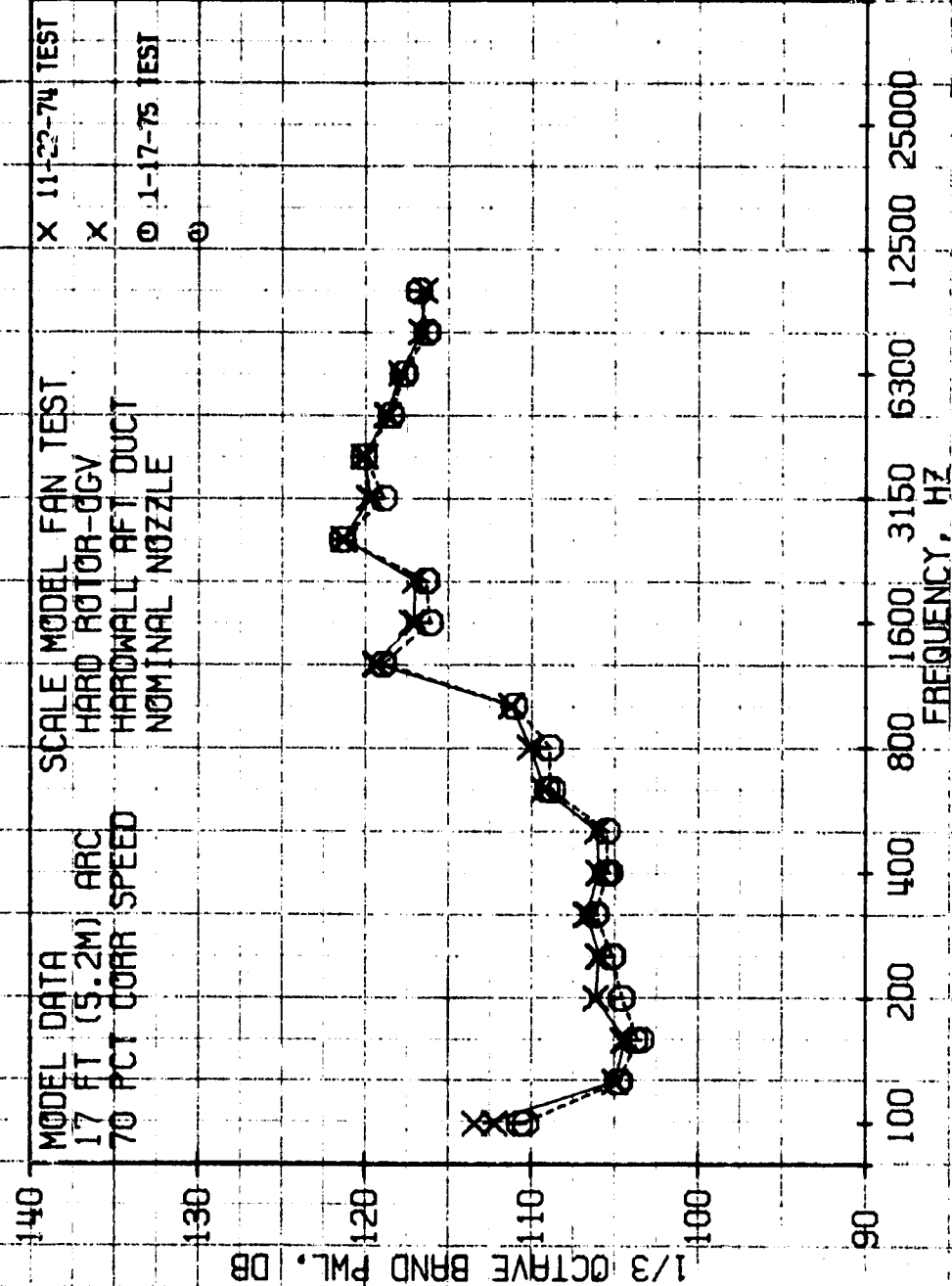


FIGURE 208

ORIGINAL PAGE  
OF POOR QUALITY

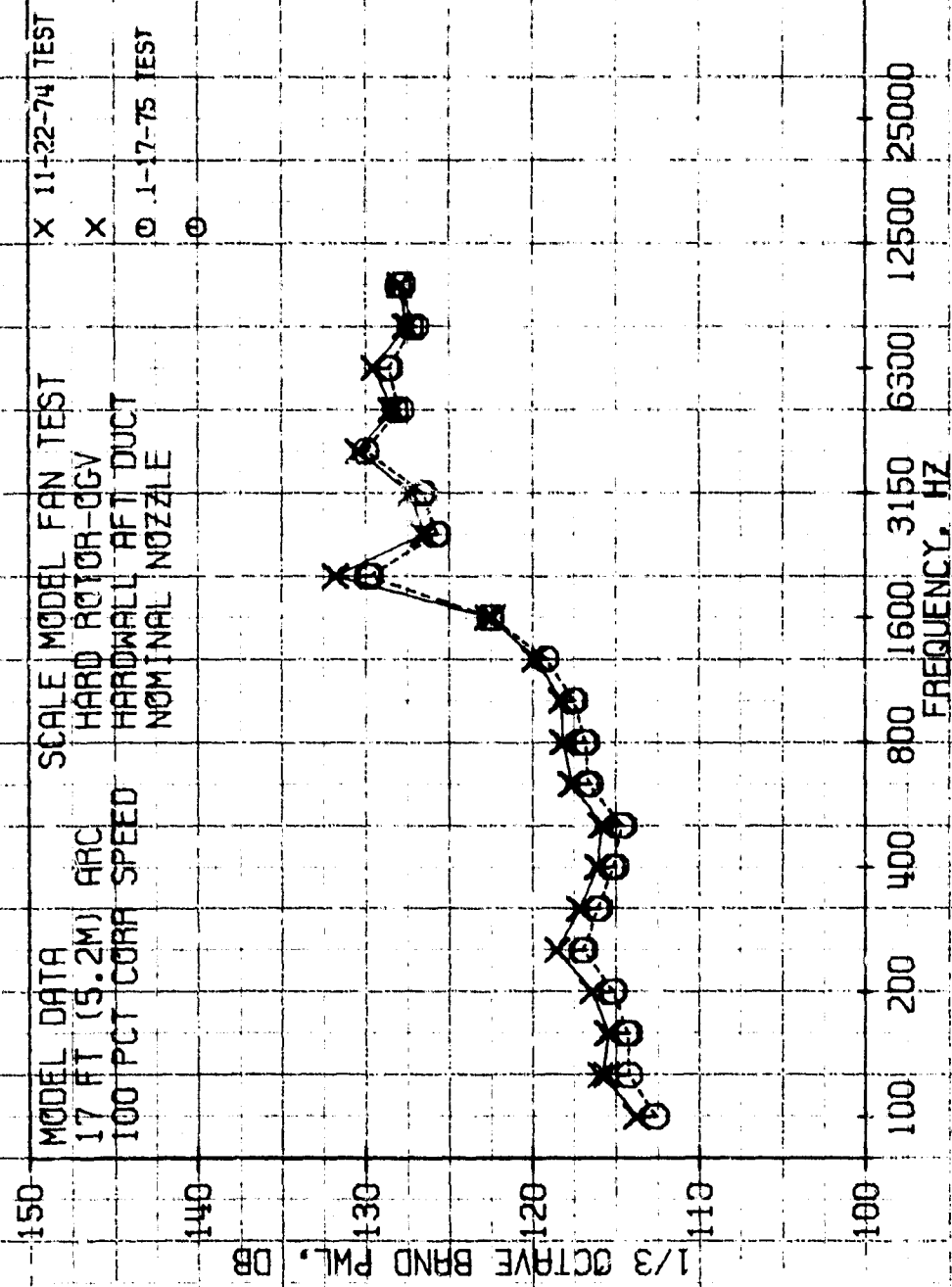


FIGURE 209



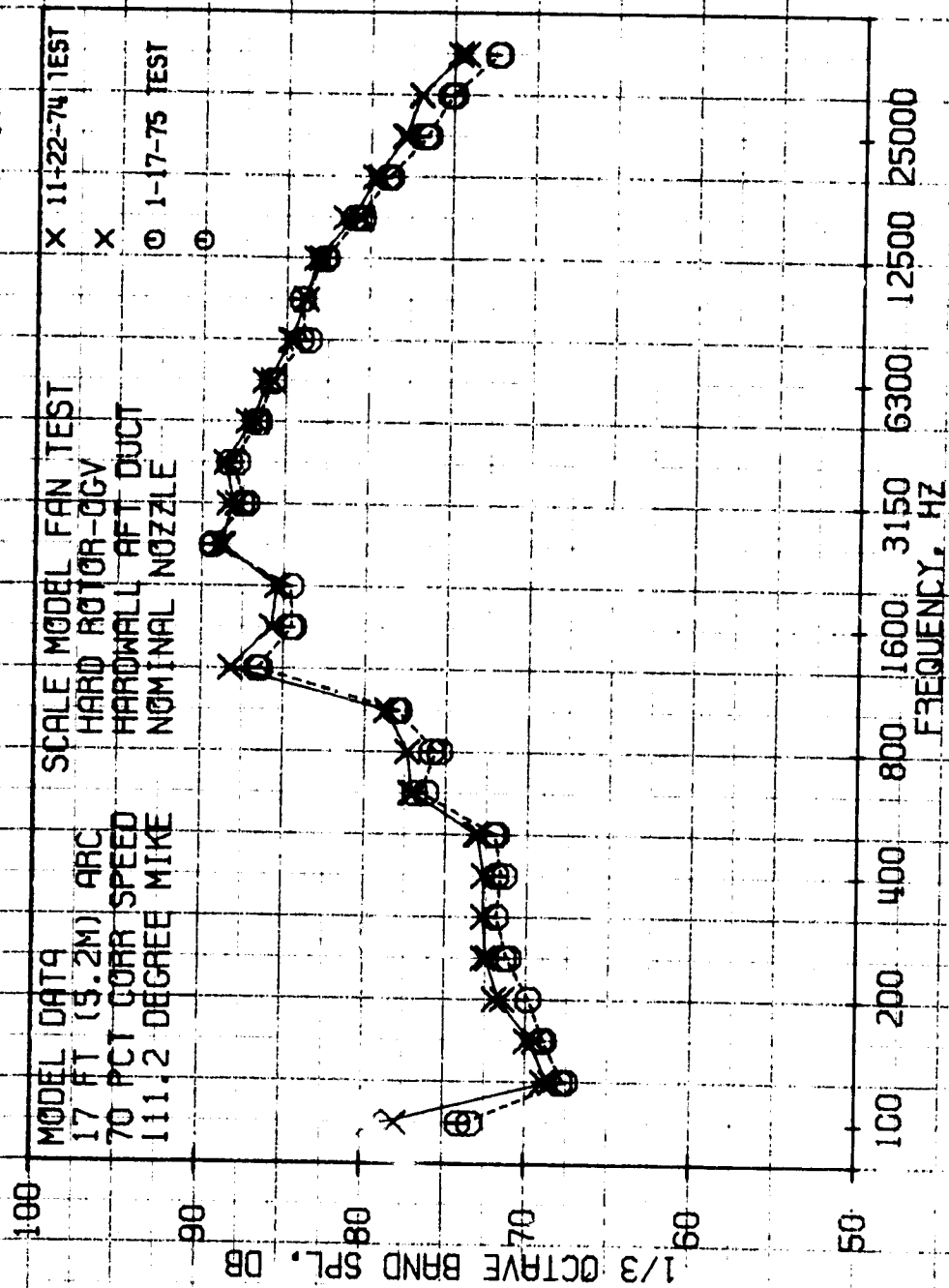


FIGURE 210

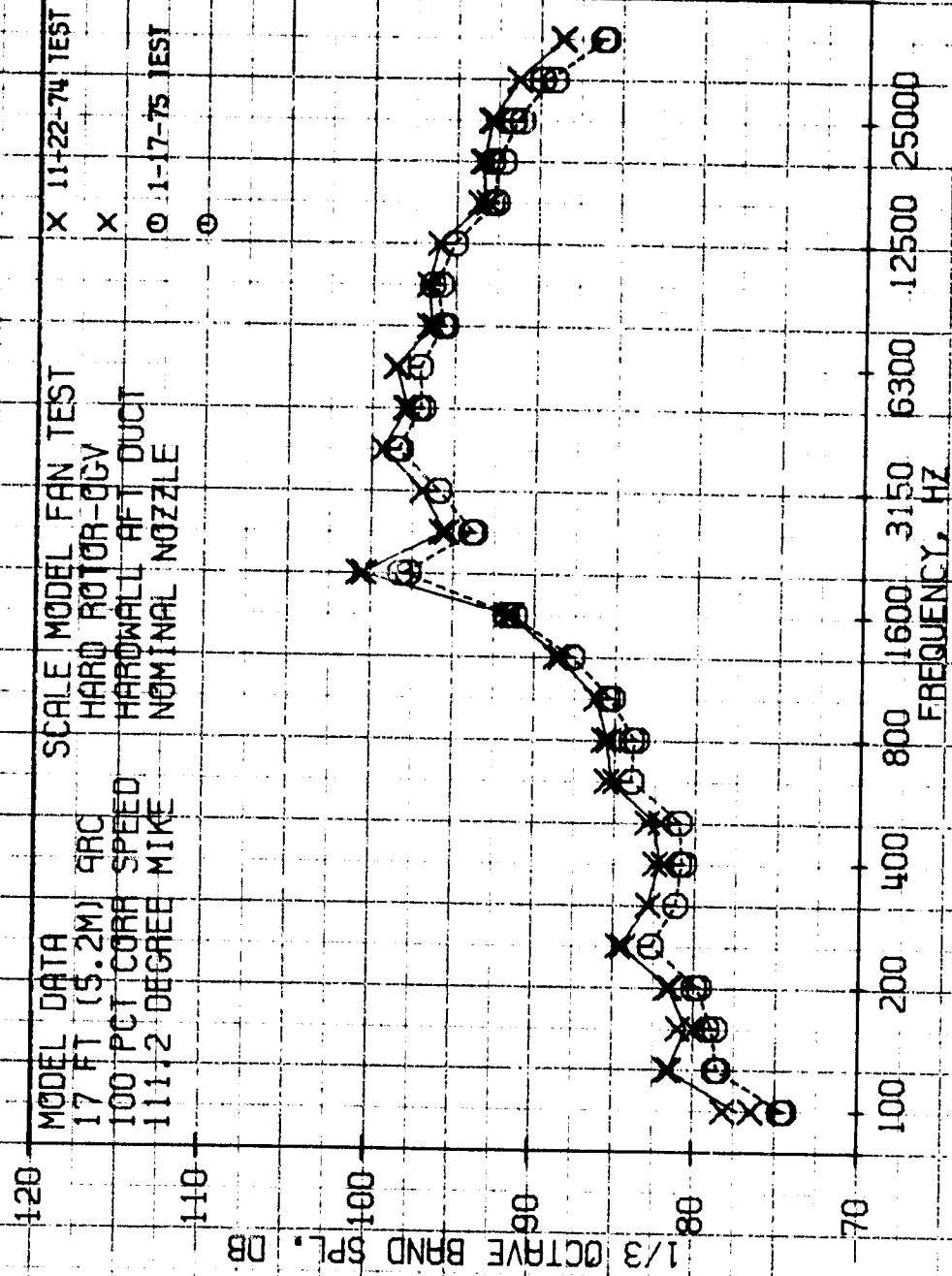


FIGURE 2II

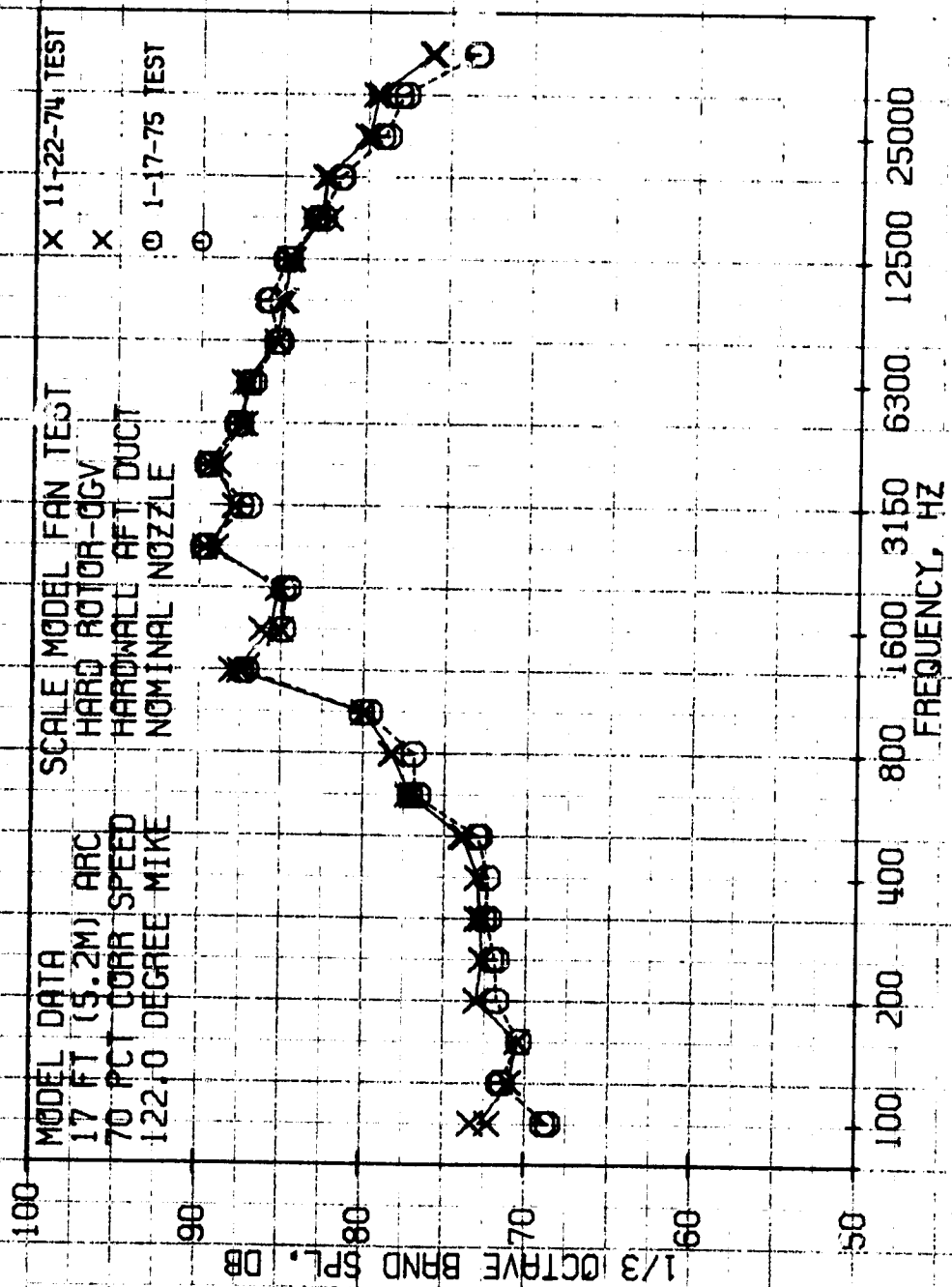


FIGURE 212

ORIGINAL PAGE IS  
OF POOR QUALITY

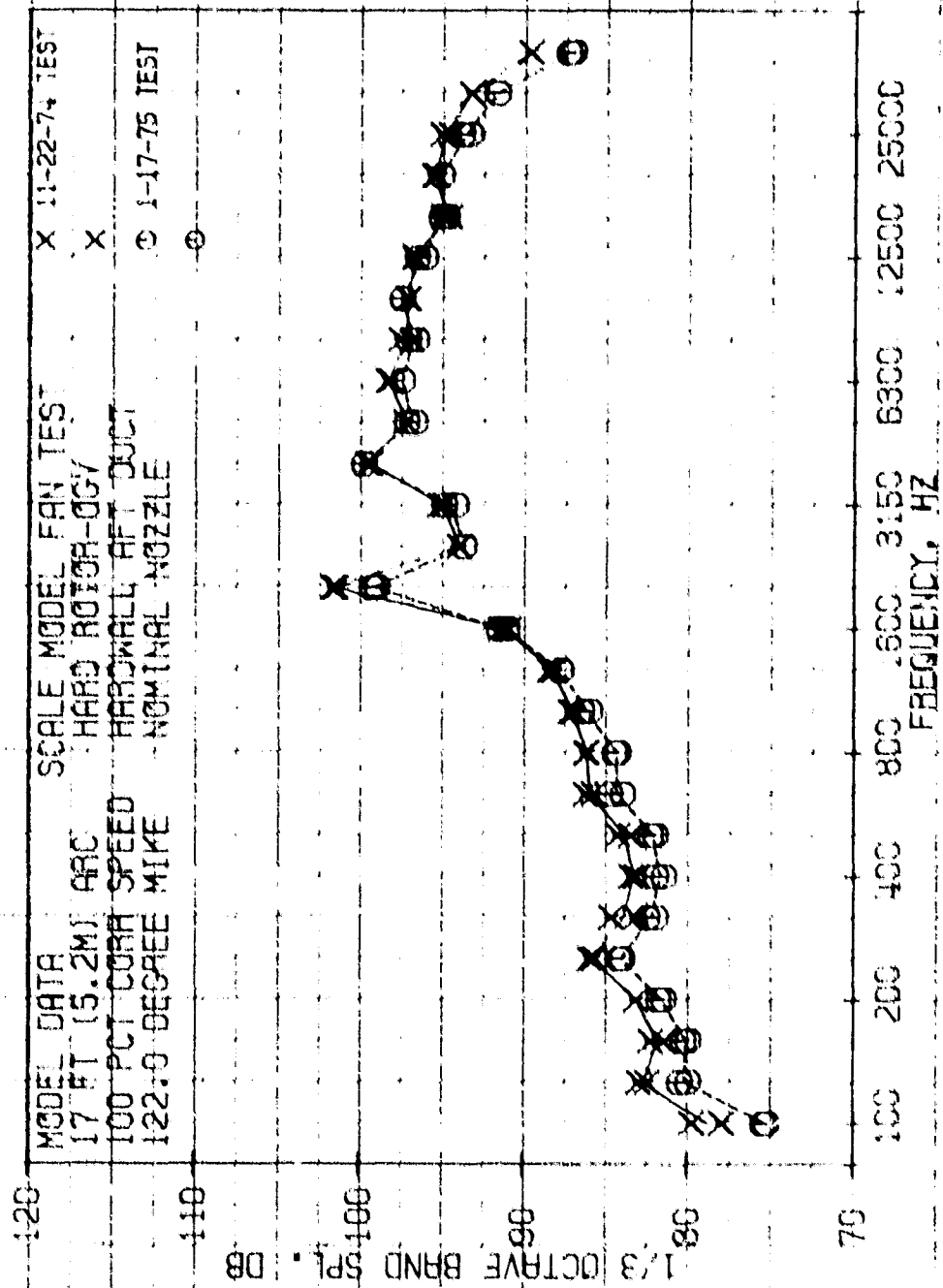
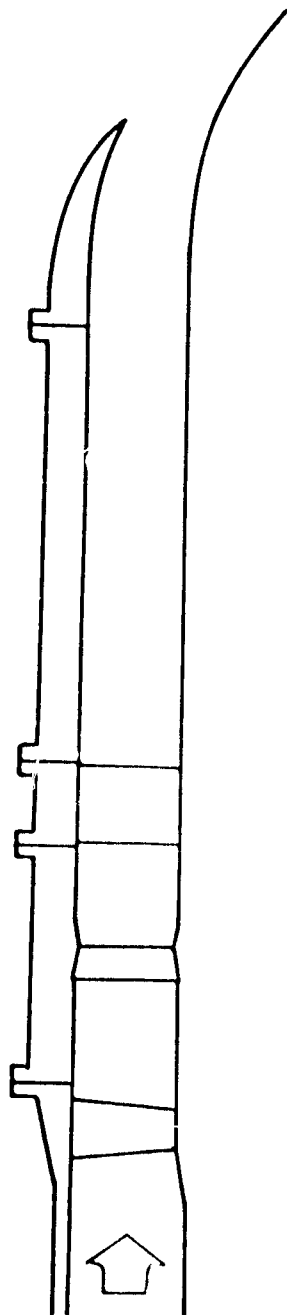
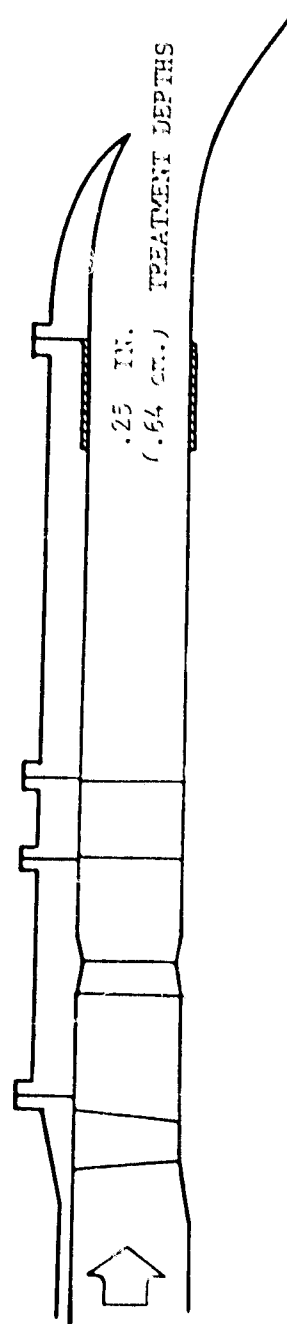


FIGURE 213

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-16, POROSITY = 27%

FIGURE 214.  $L/H = 1.15$ , 27 PERCENT POROSITY, 0.25 INCH (.64 CM) CONFIGURATION

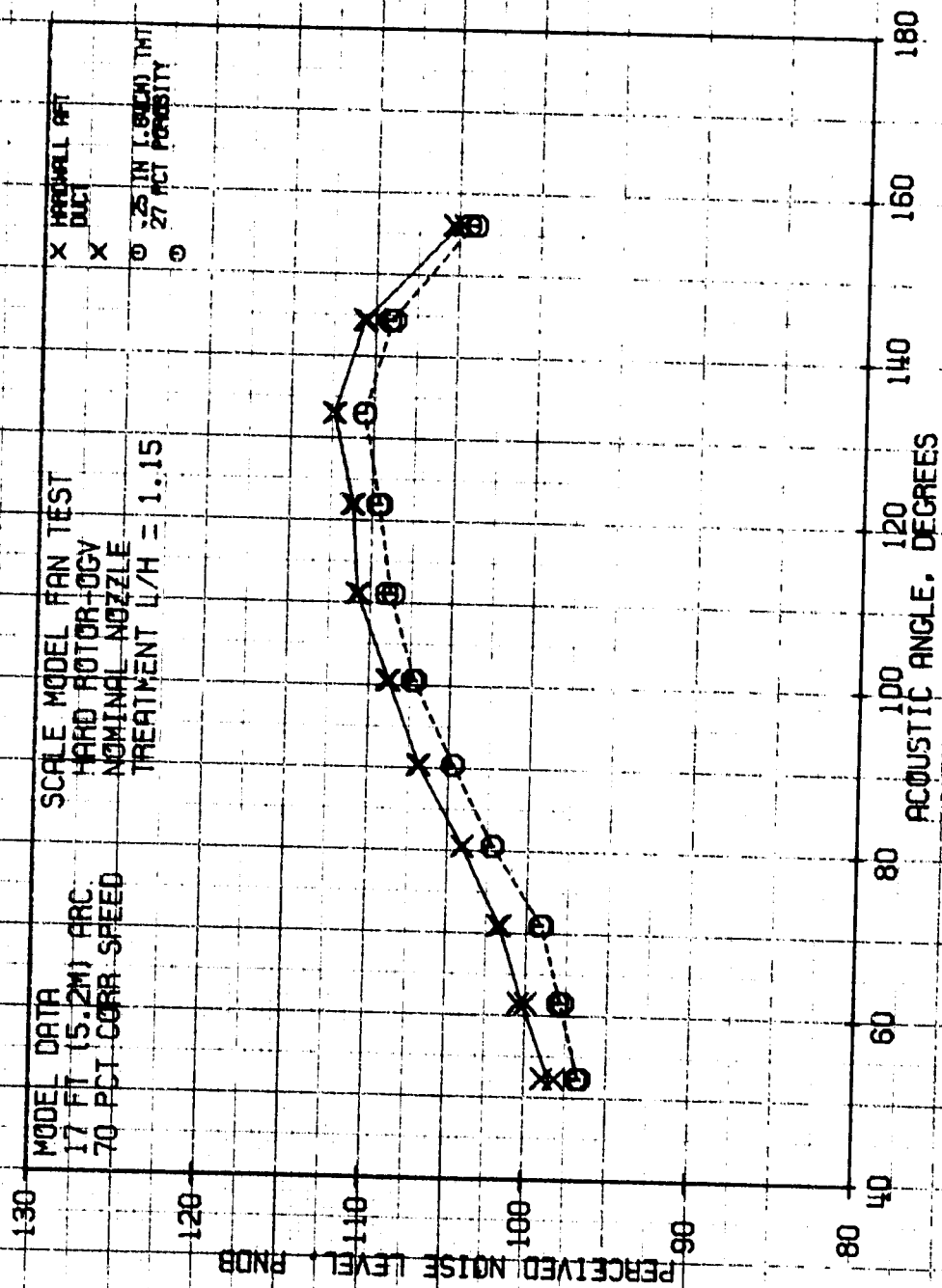


FIGURE 215

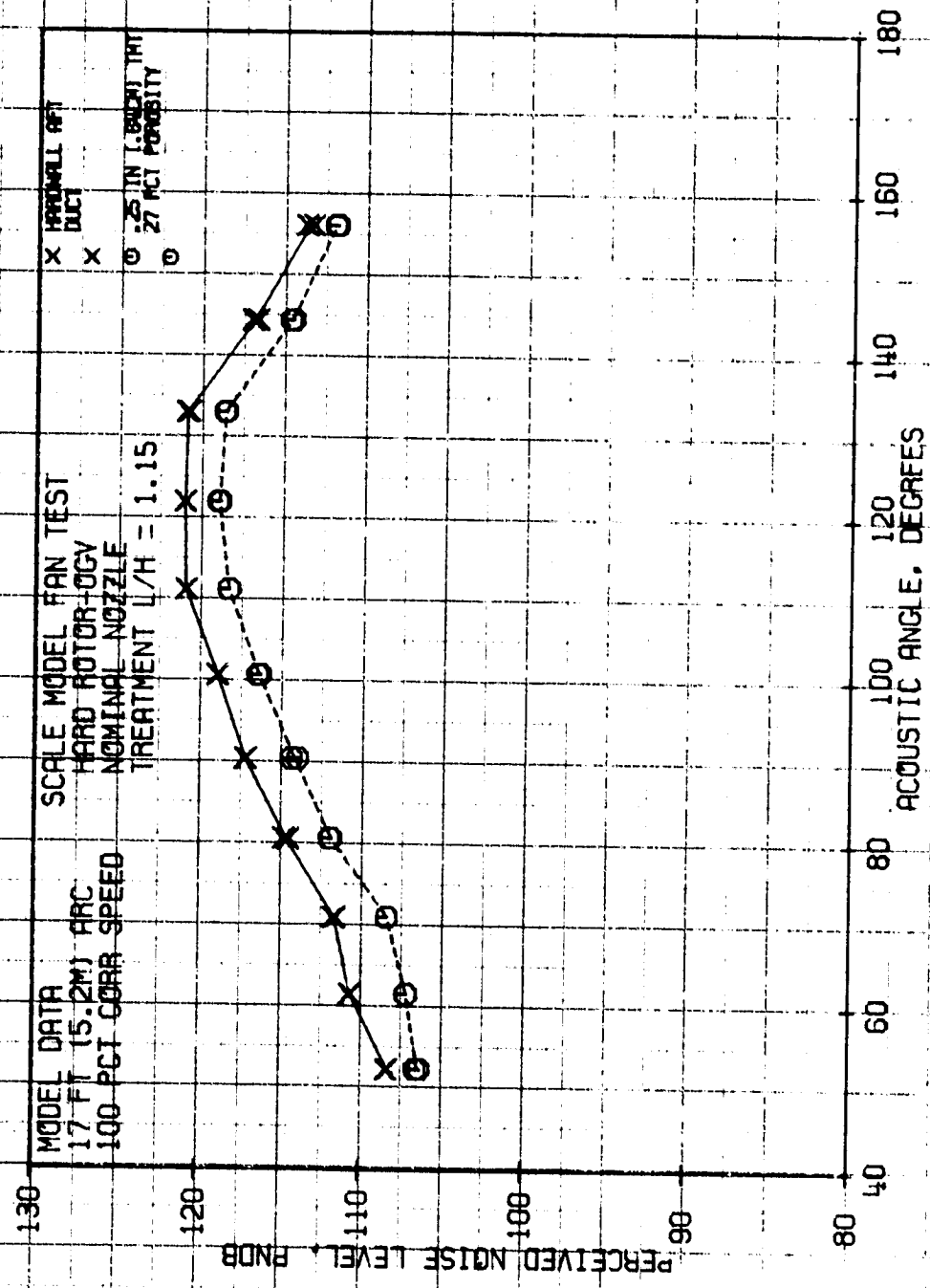


FIGURE 216

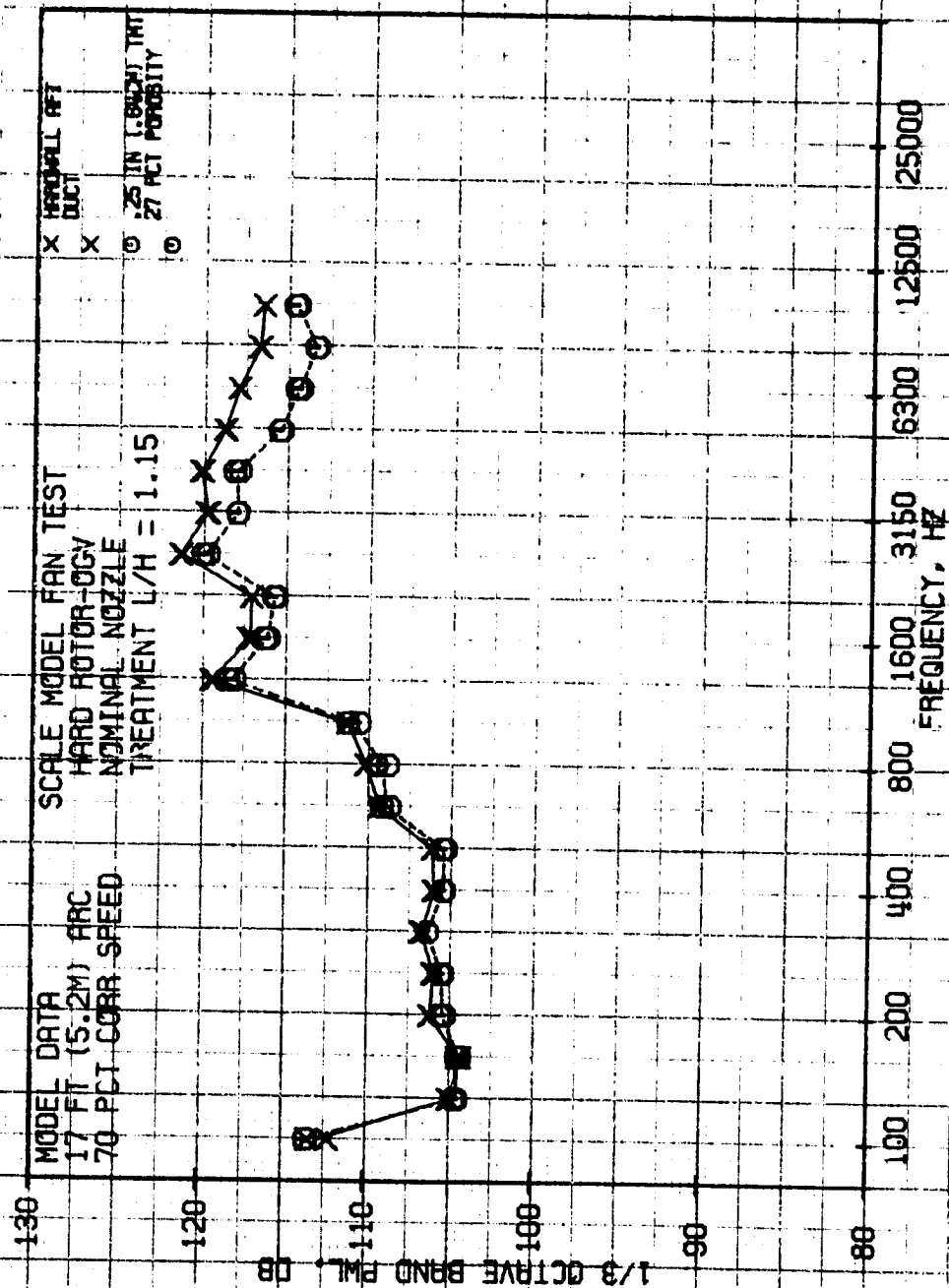


FIGURE 217



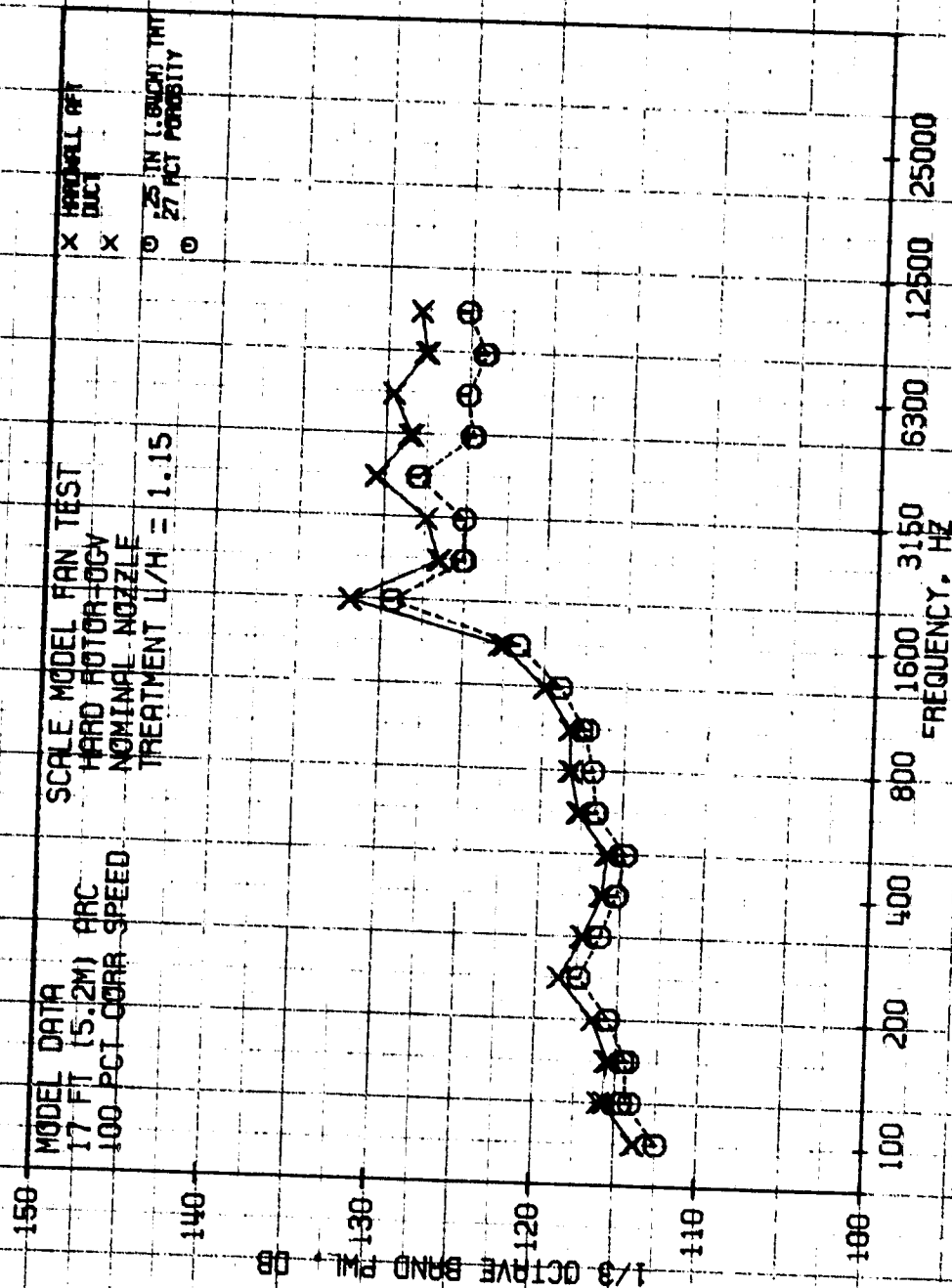


FIGURE 218

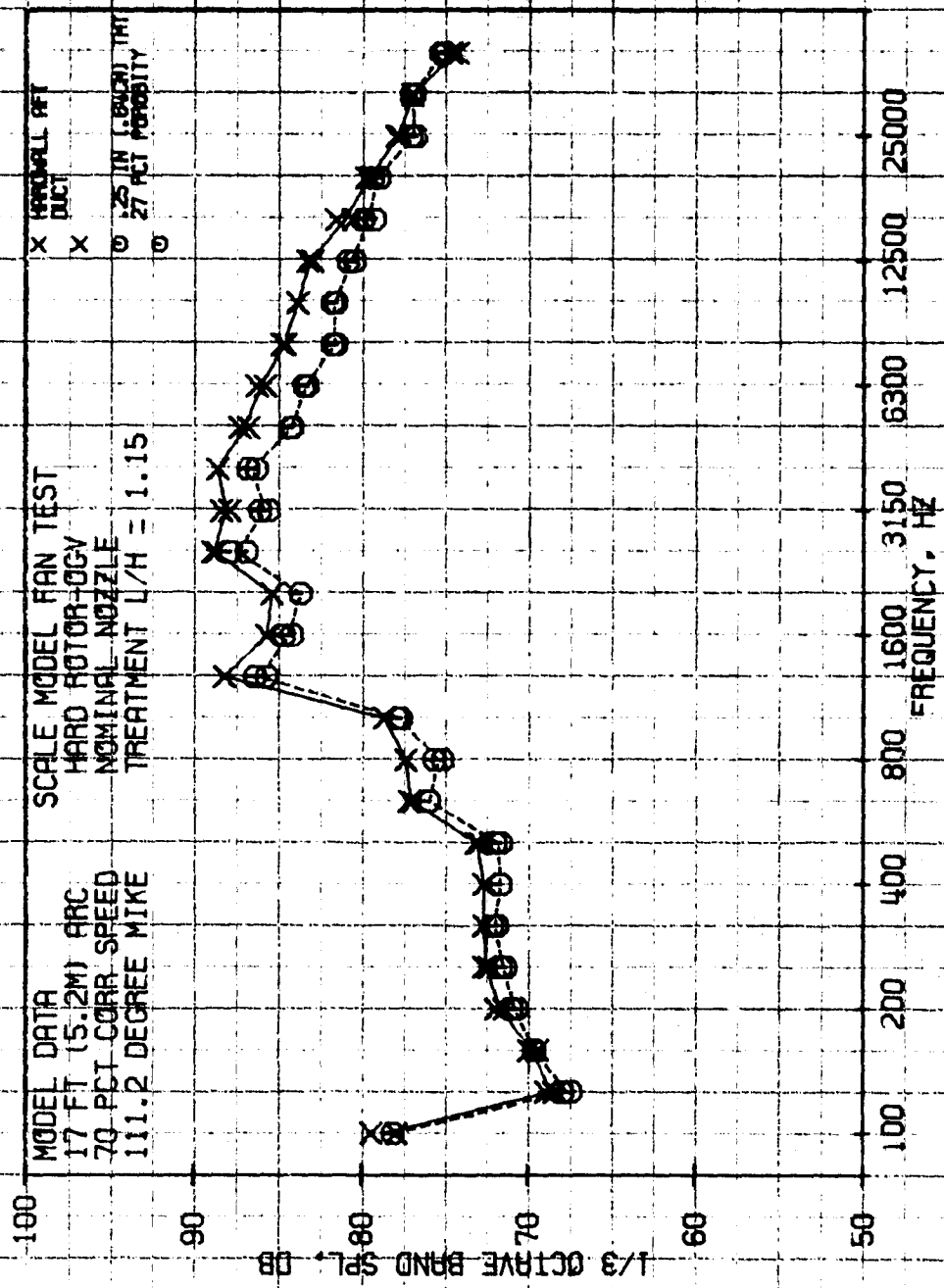


FIGURE 219

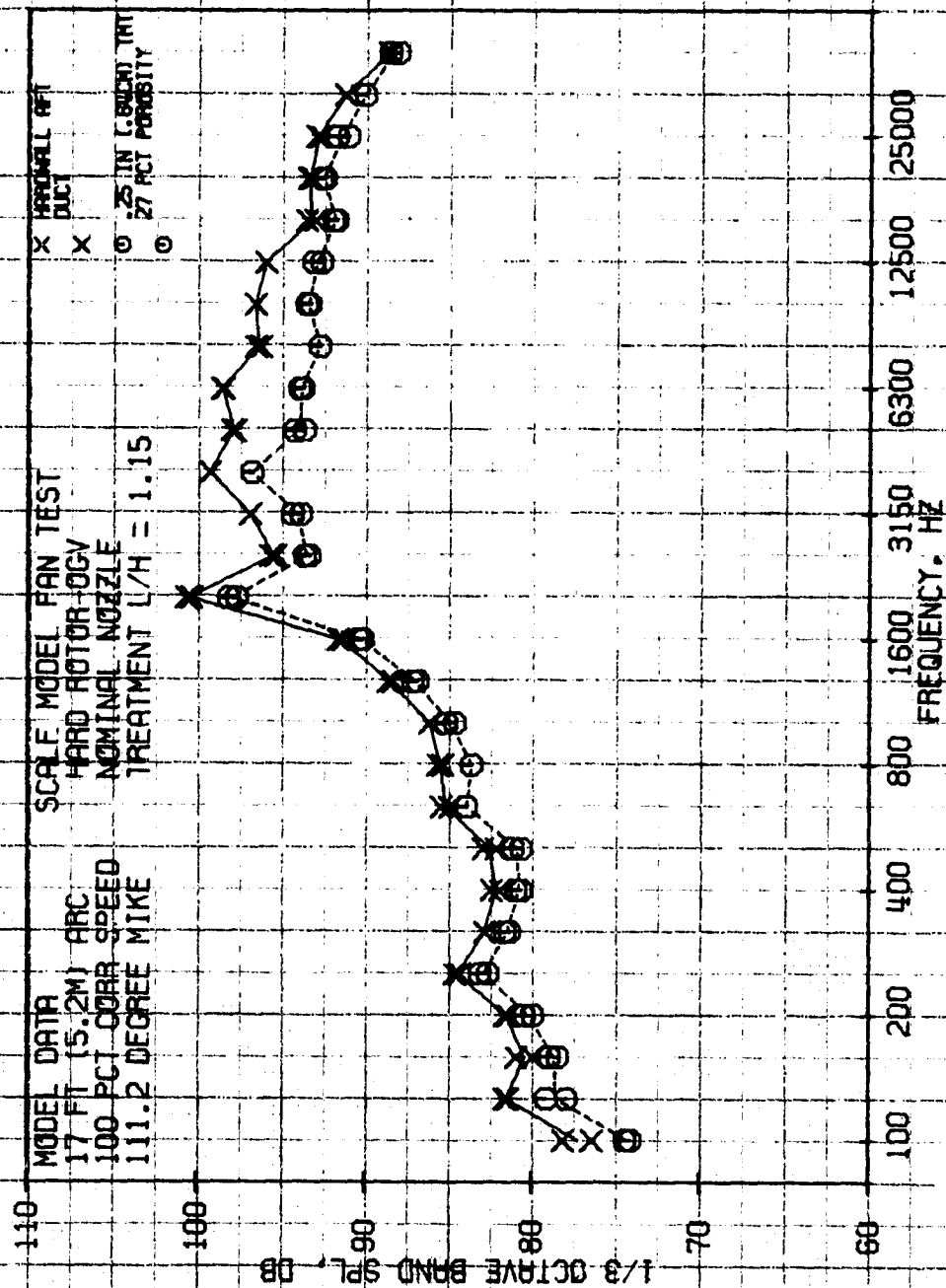


FIGURE 220

ORIGINAL PAGE IS  
OF POOR QUALITY

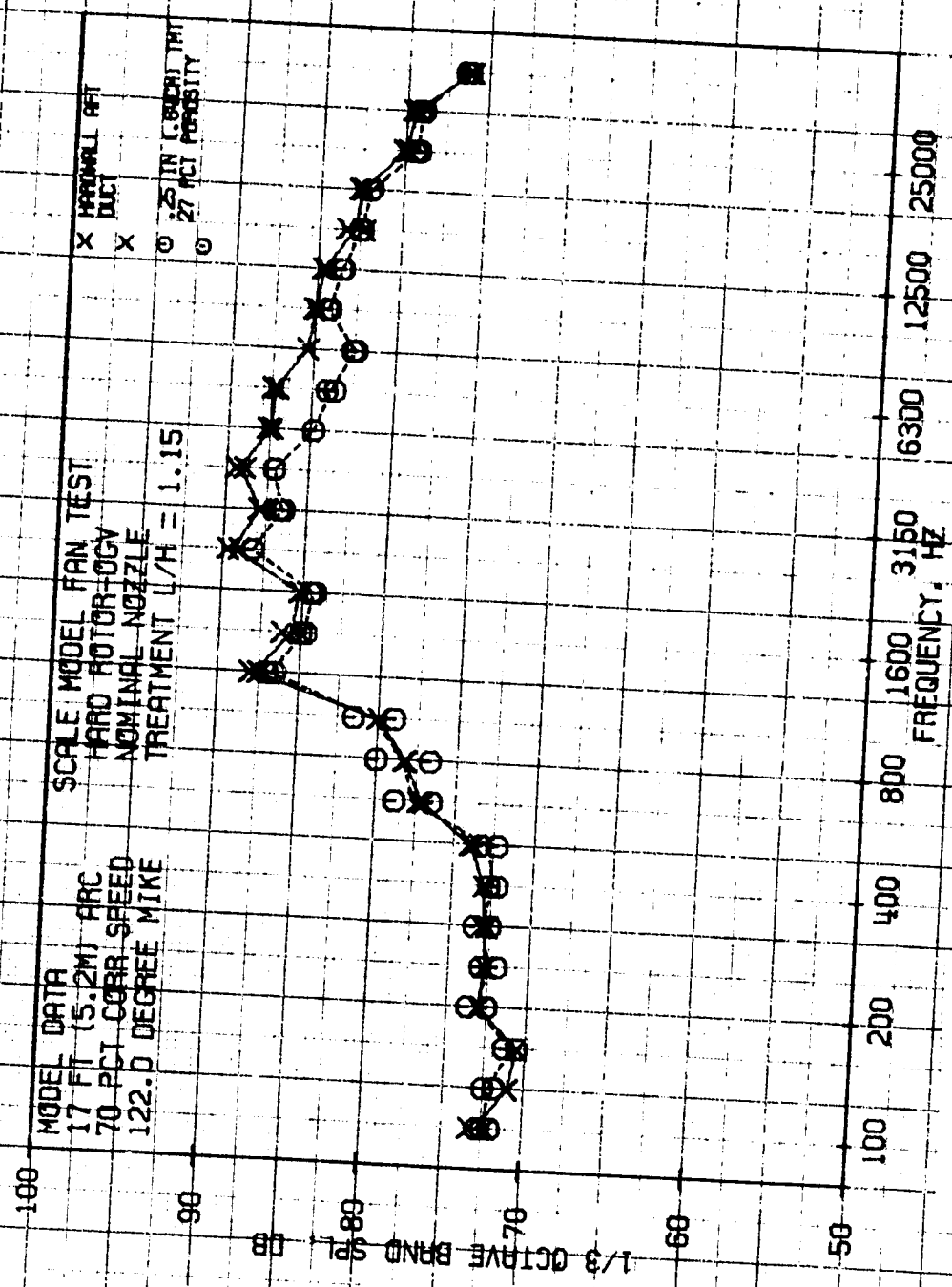


FIGURE 221

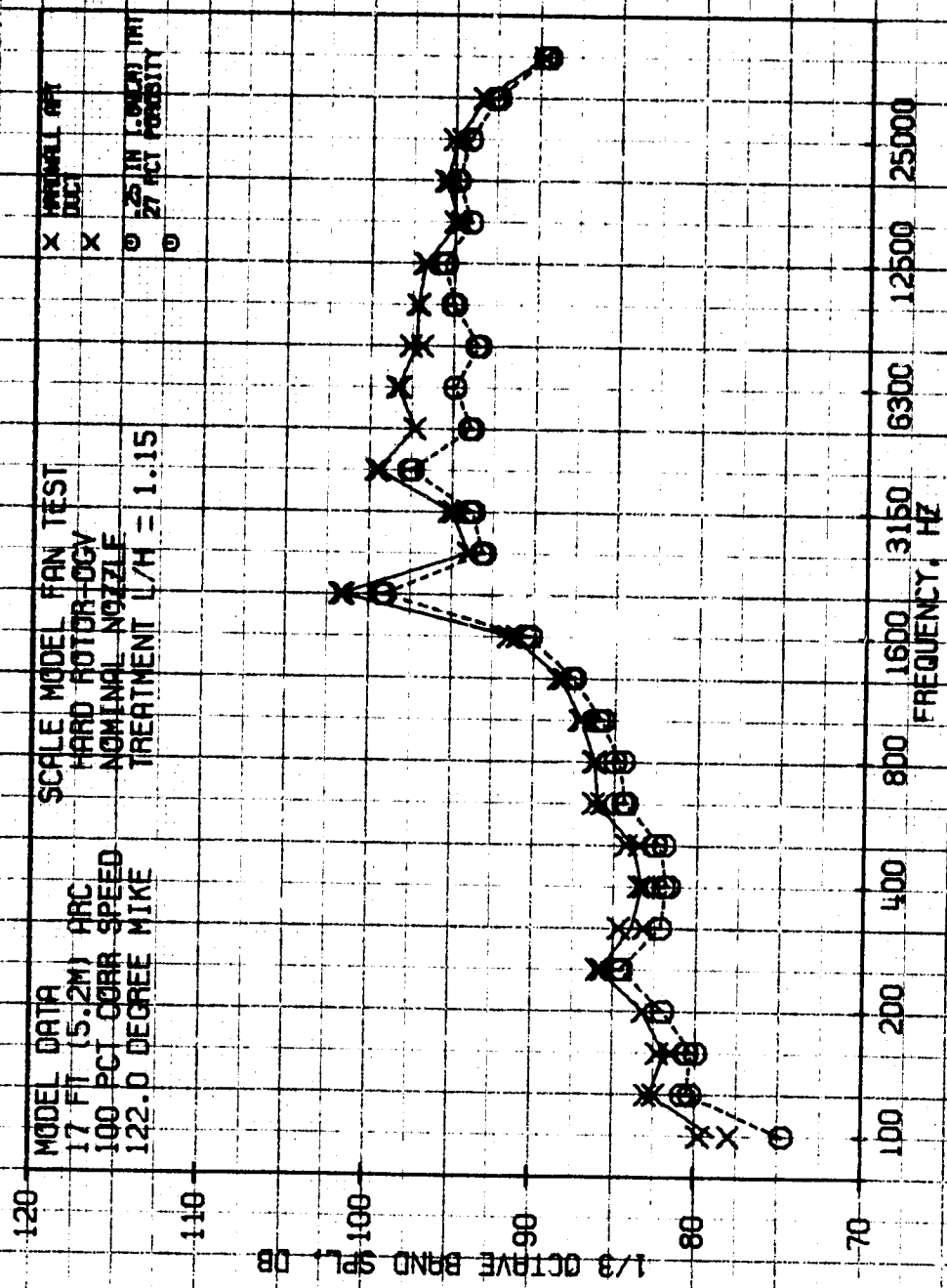
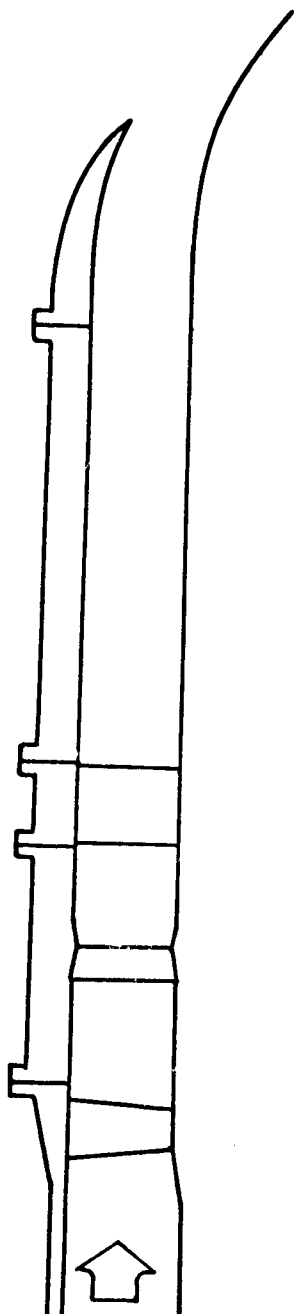


FIGURE 222

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1H, POROSITY = 27%

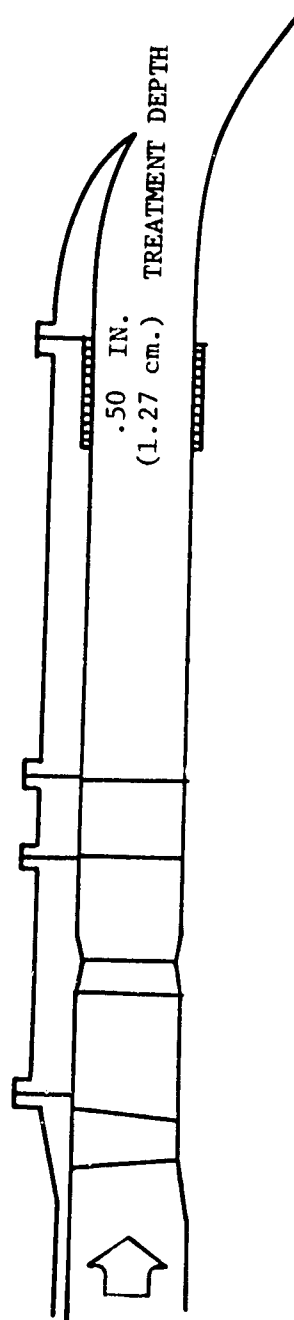


FIGURE 223.  $L/H = 1.15$ , 27 PERCENT POROSITY, 0.50 INCH (1.27 cm) CONFIGURATION

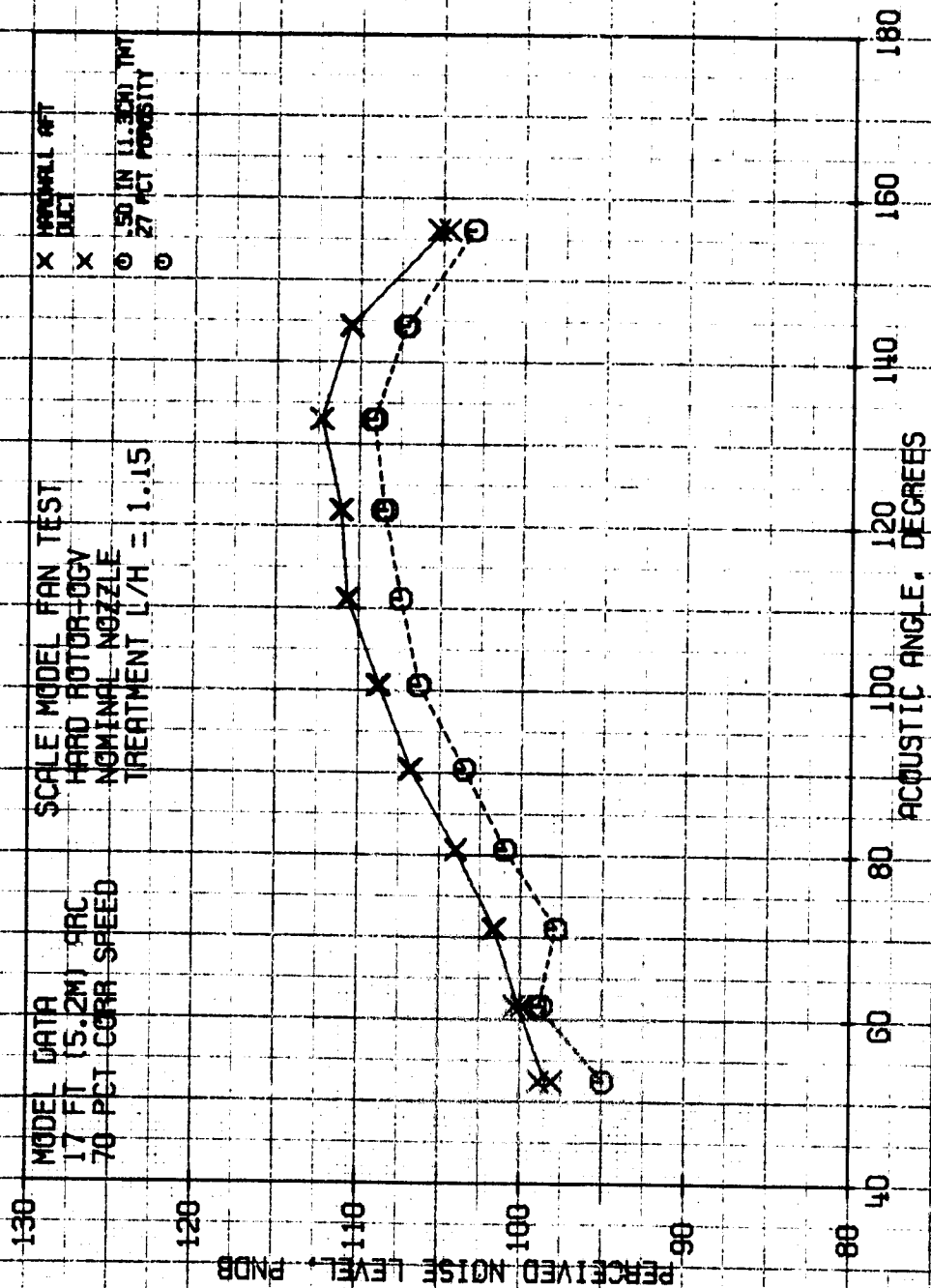


FIGURE 224

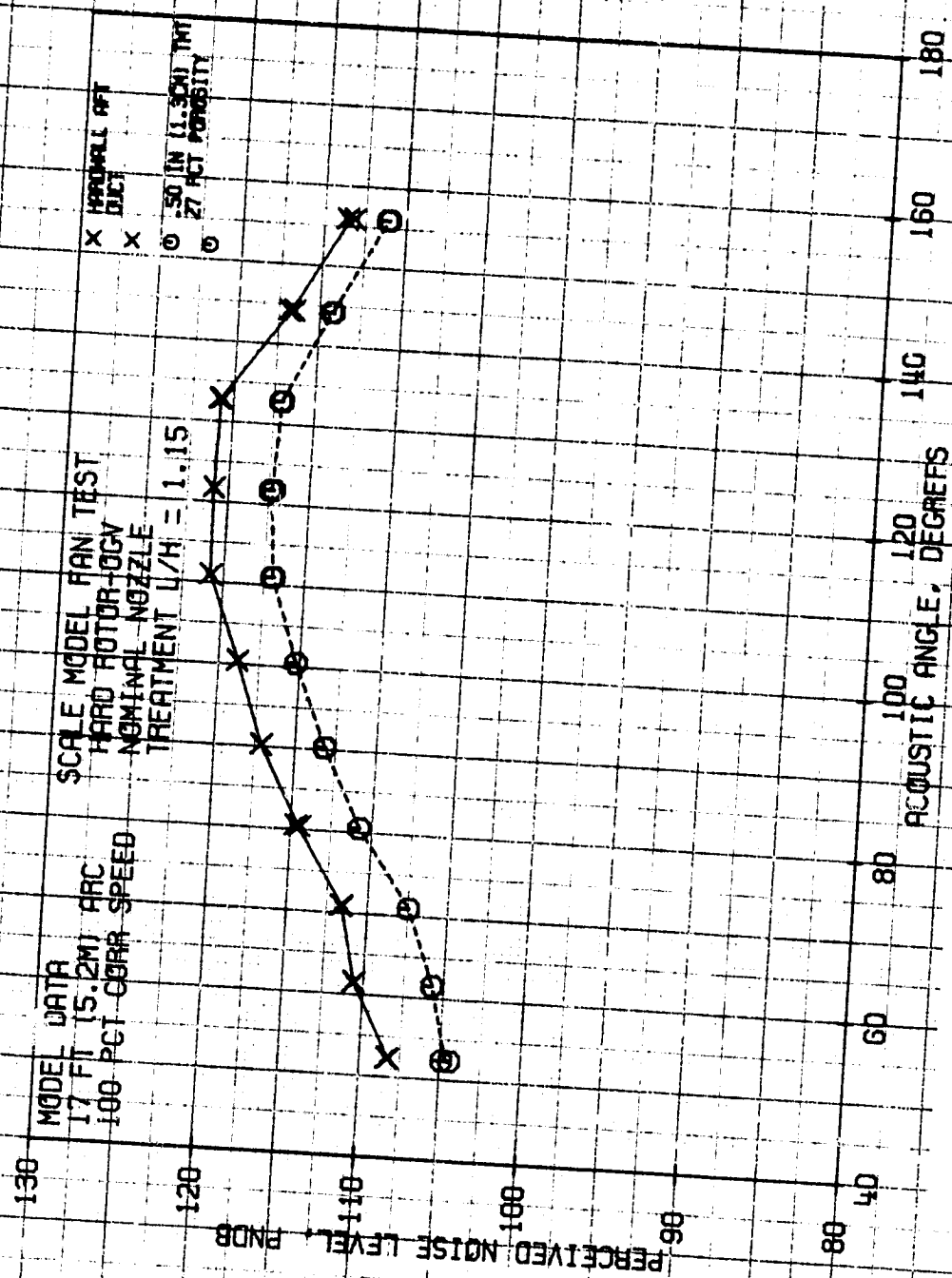


FIGURE 225



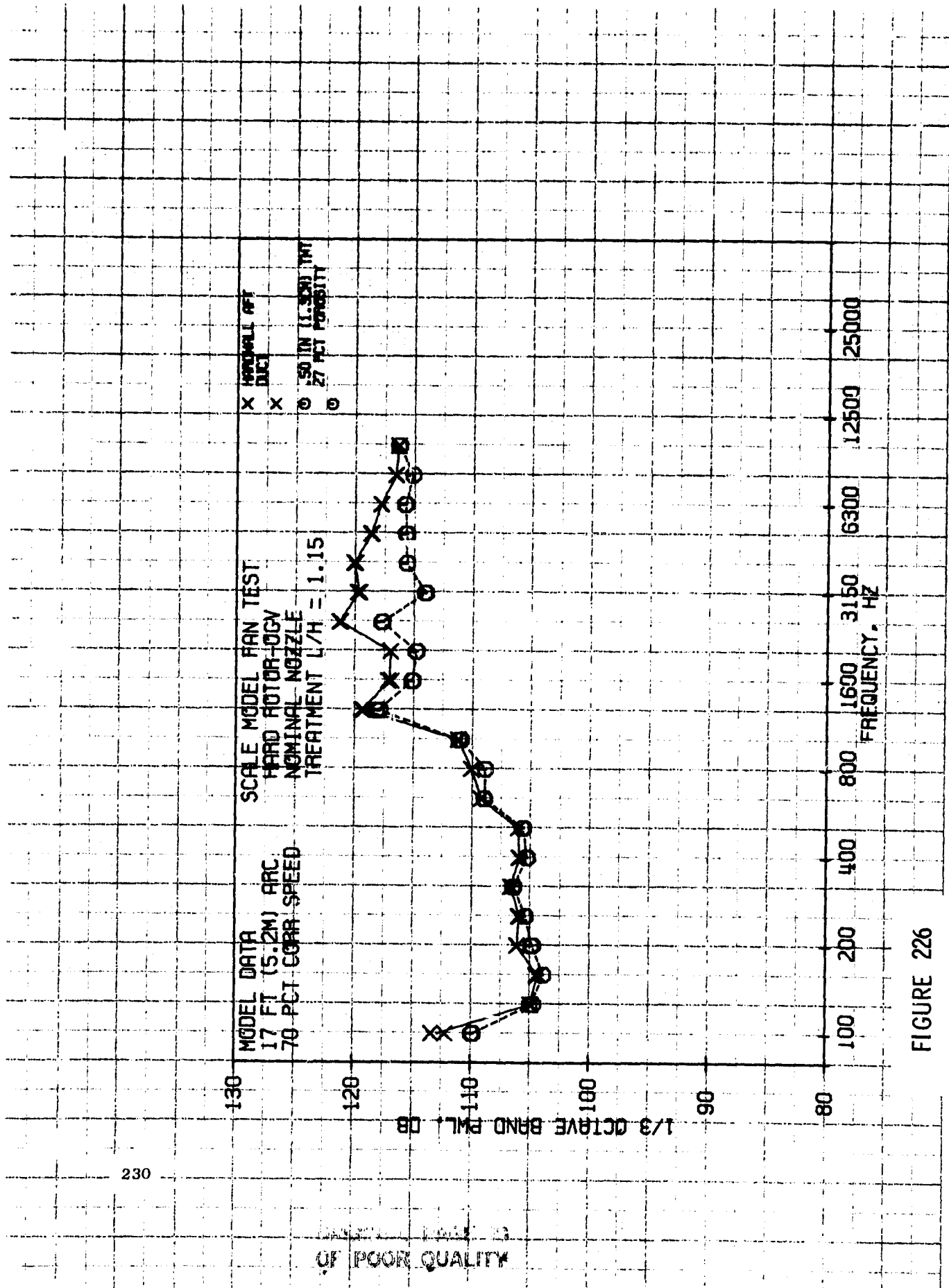


FIGURE 226

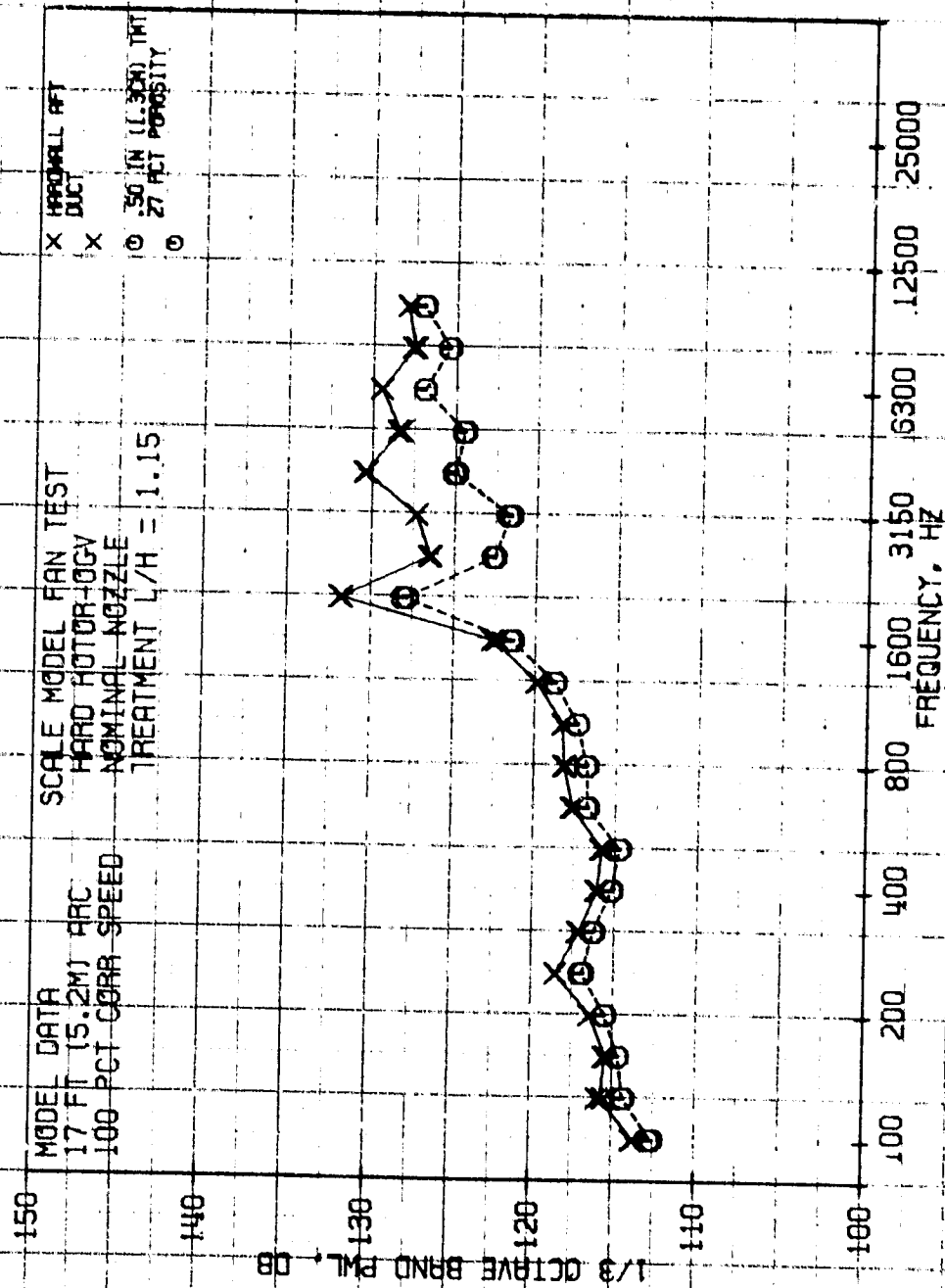


FIGURE 227

MODEL DATA  
 17 FT (5.2M) ARC  
 70 PCT CORR SPEED  
 111.2 DEGREE MIKE

SCALE MODEL FAN TEST  
 HARD ROTOR-OGV  
 NOMINAL NOZZLE  
 TREATMENT L/H = 1.15

X HANDALL AFT  
 O 150 IN (3.80) TWT  
 O 27 PCT POROSITY

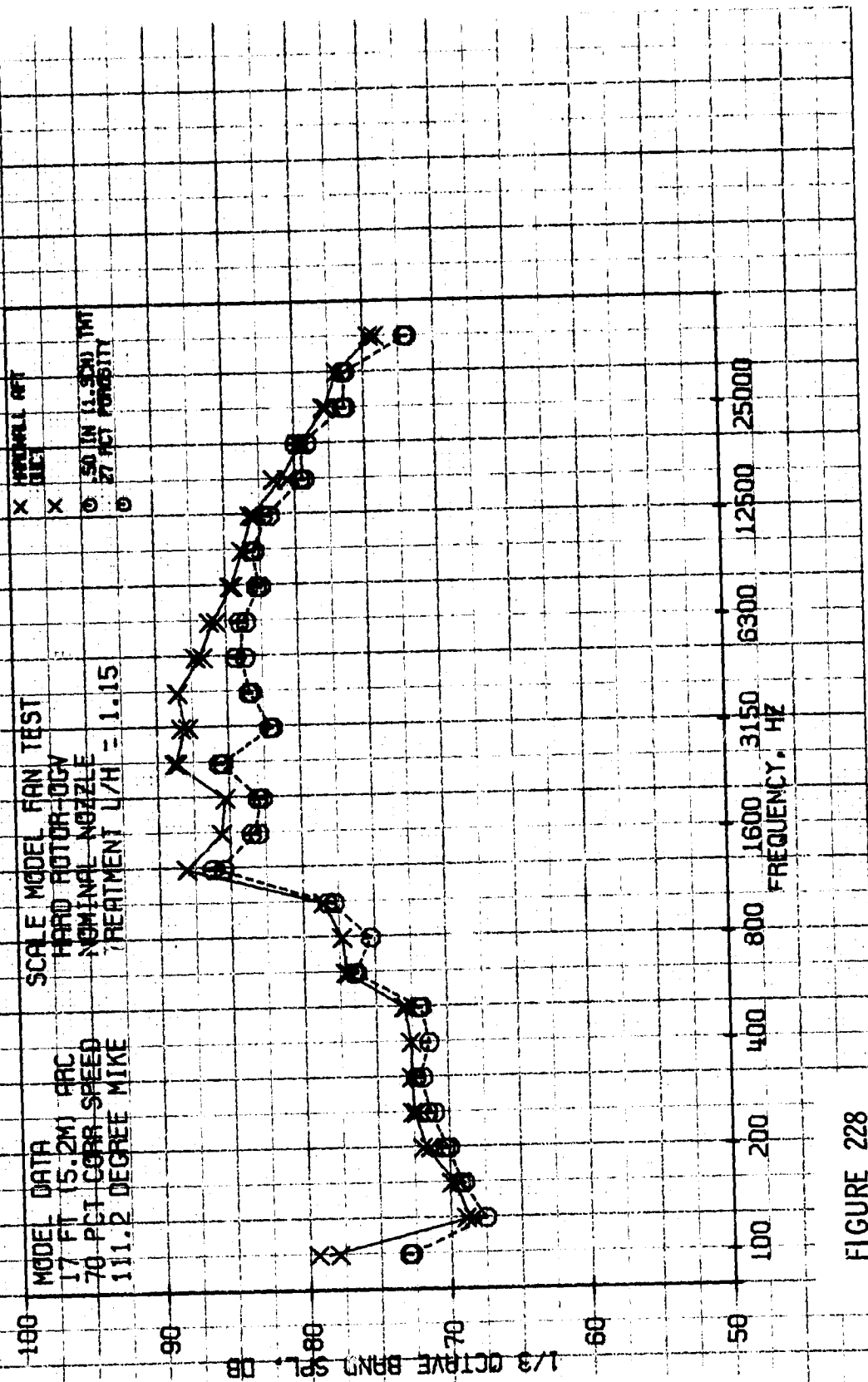


FIGURE 228

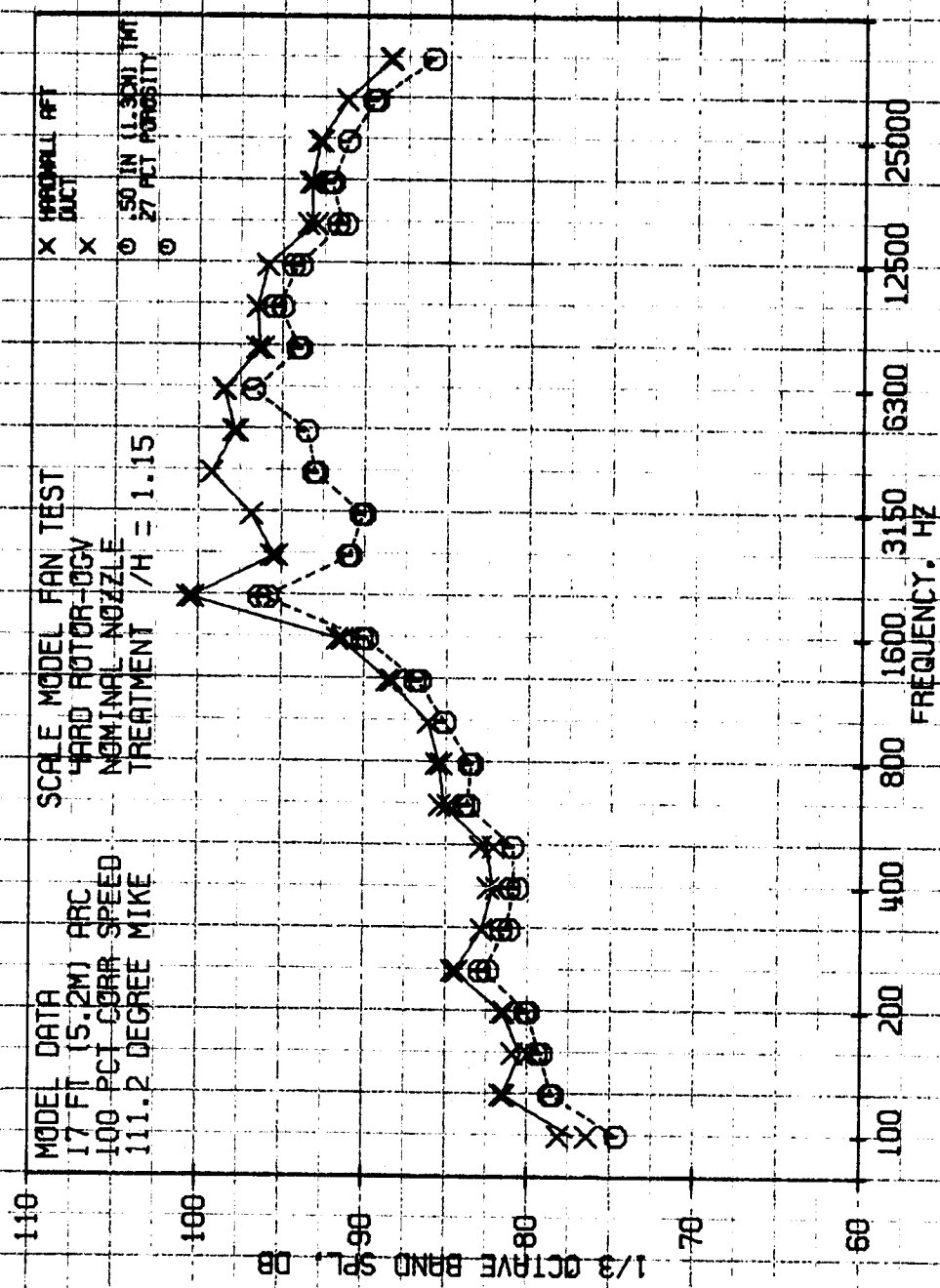


FIGURE 229

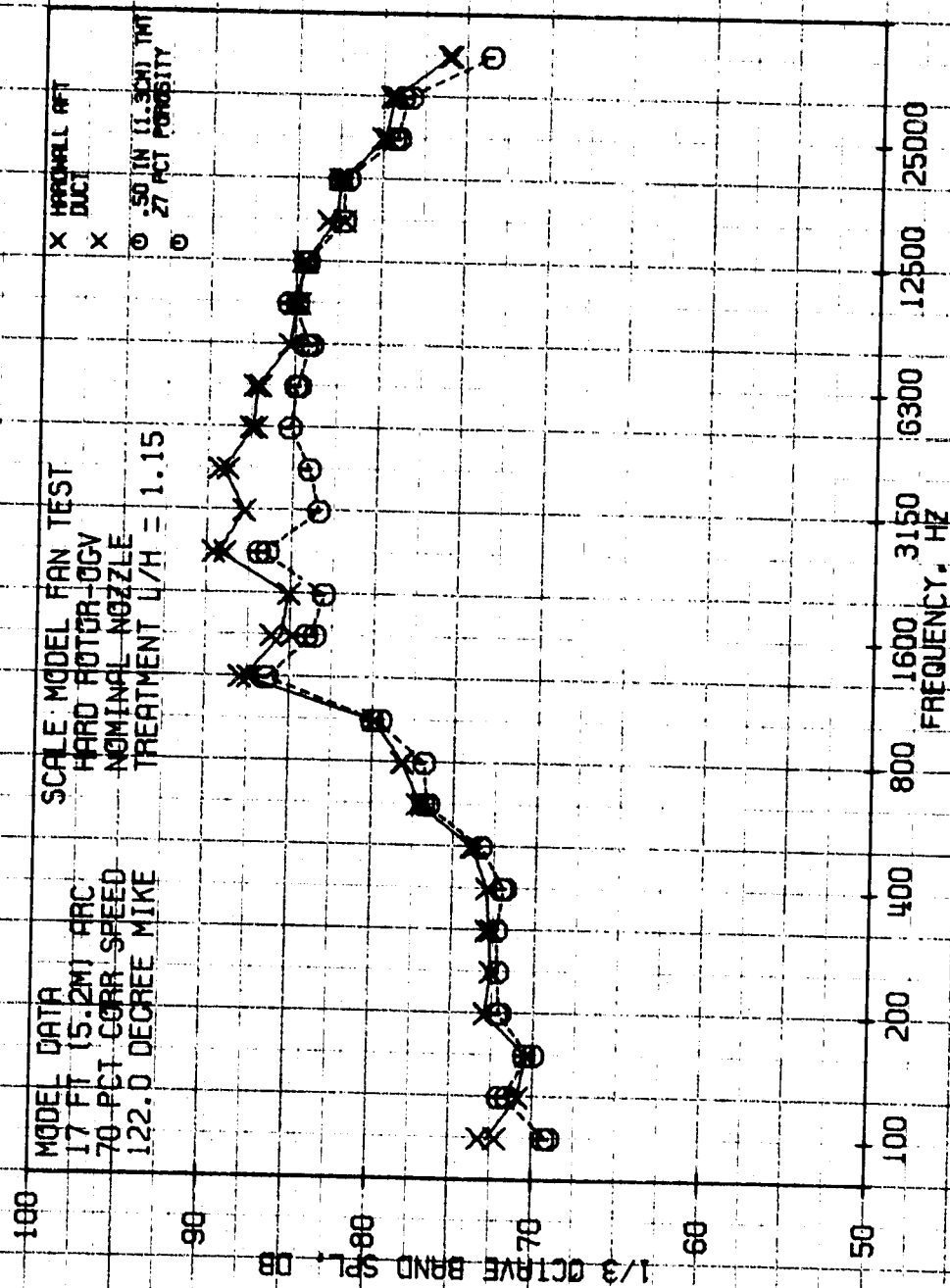


FIGURE 230

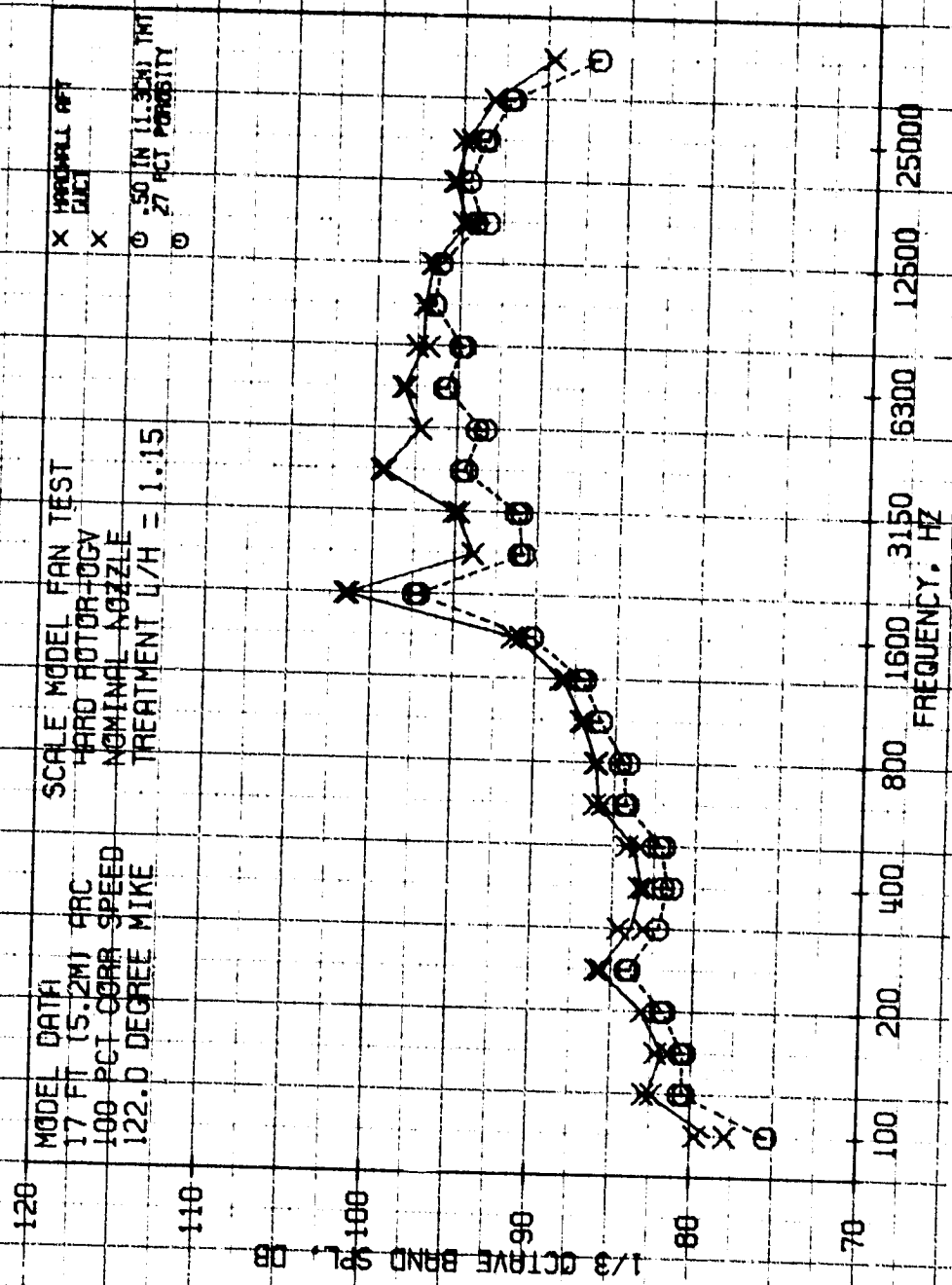
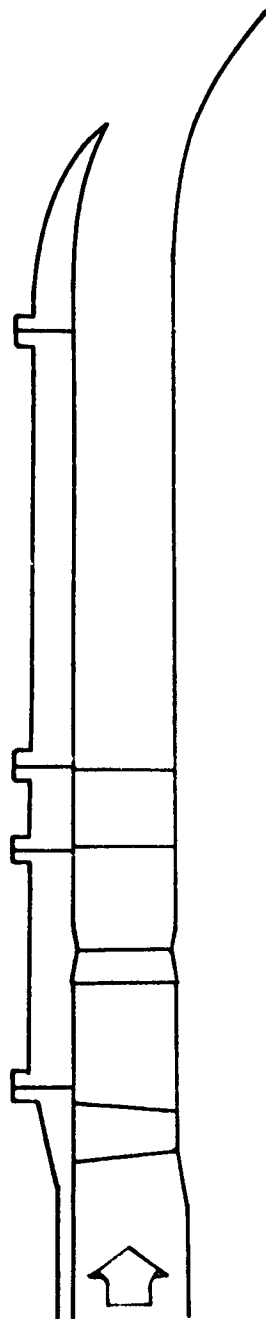
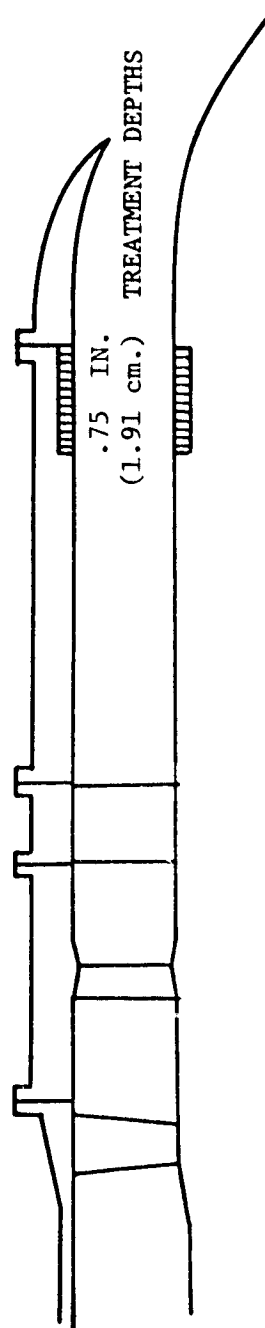


FIGURE 231

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1 I, POROSITY = 27%

FIGURE 232  $L/H = 1.15$ , 27 PERCENT POROSITY, 0.75 INCH (1.91 cm) CONFIGURATION

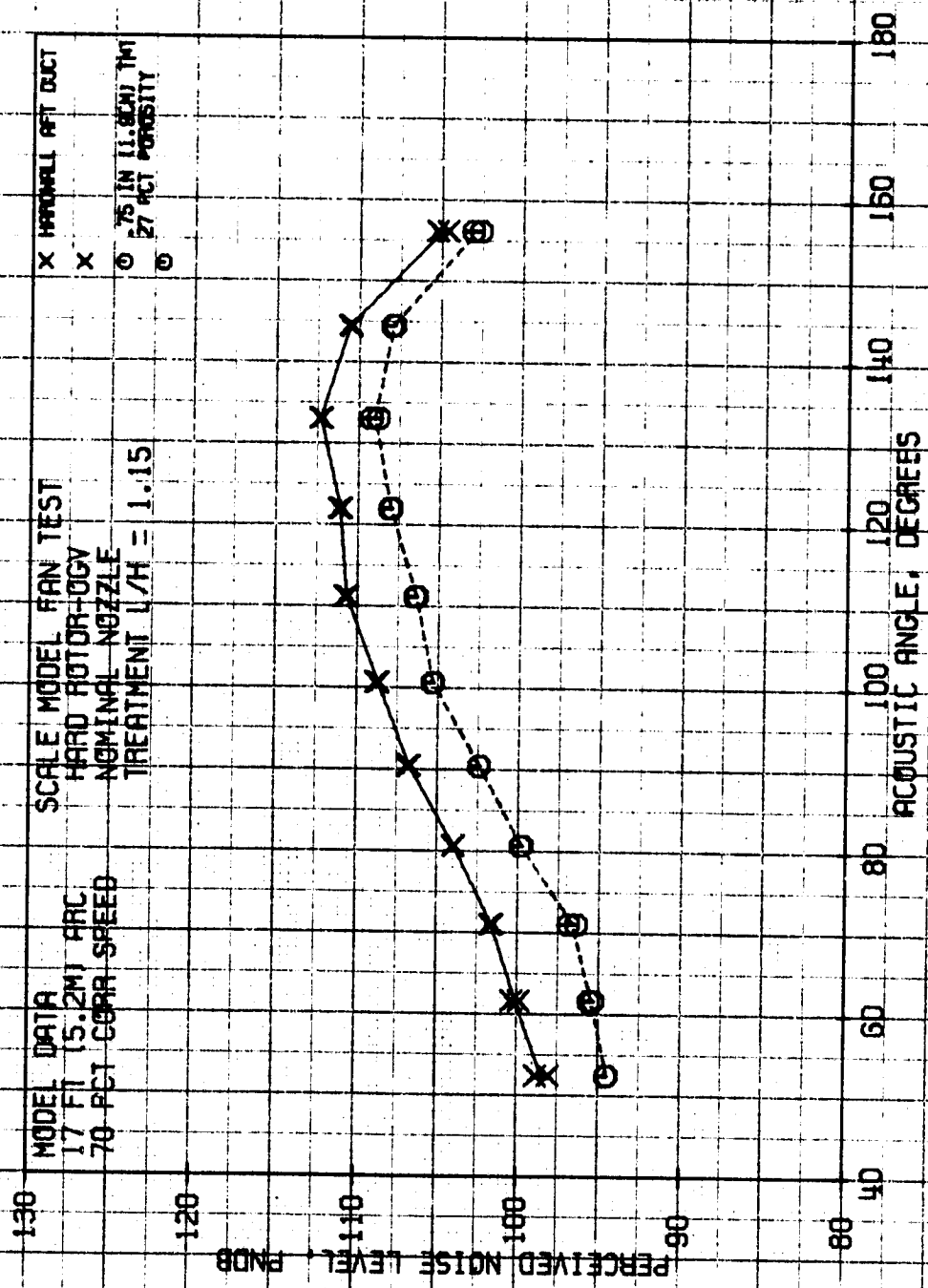


FIGURE 233



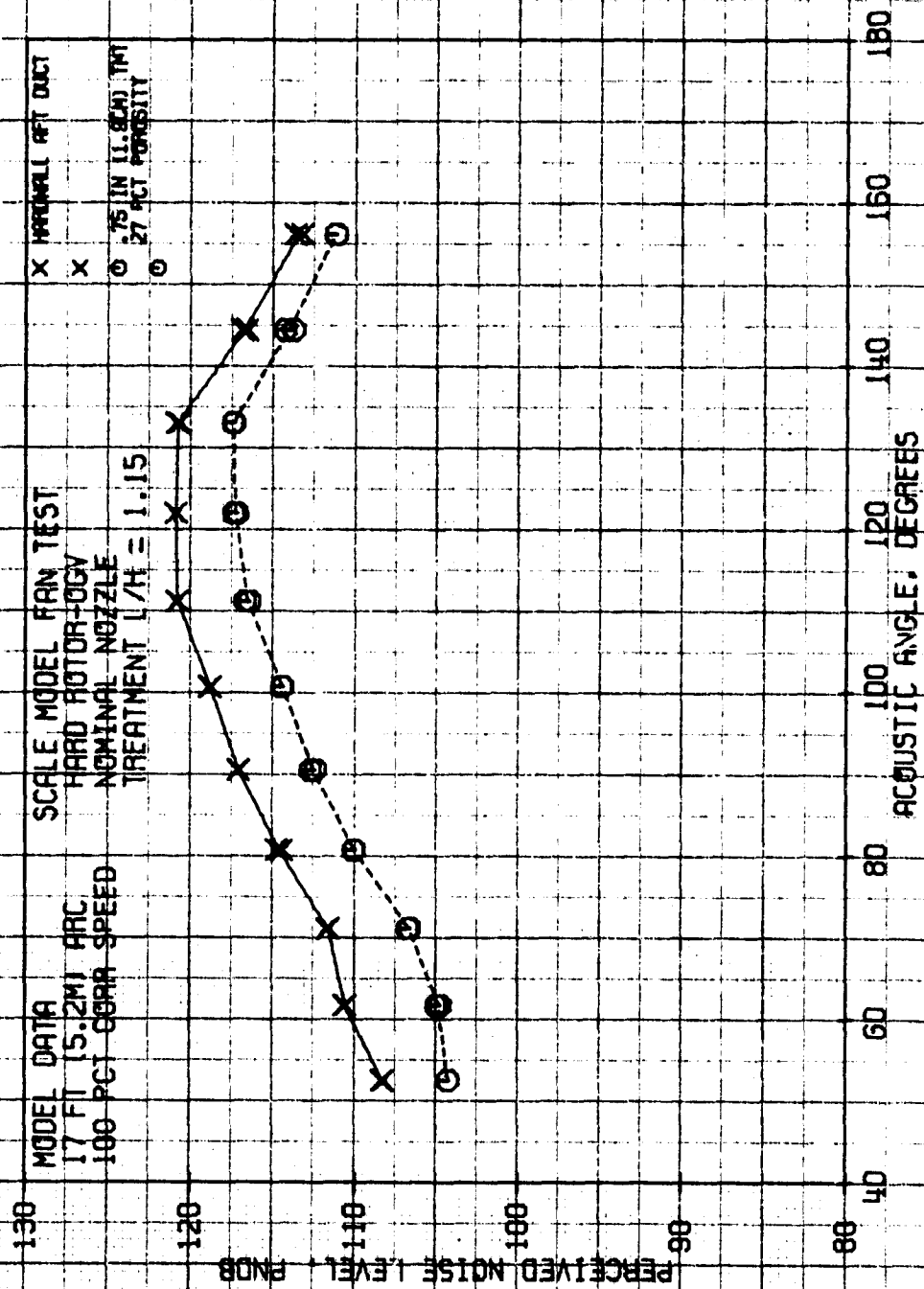


FIGURE 234

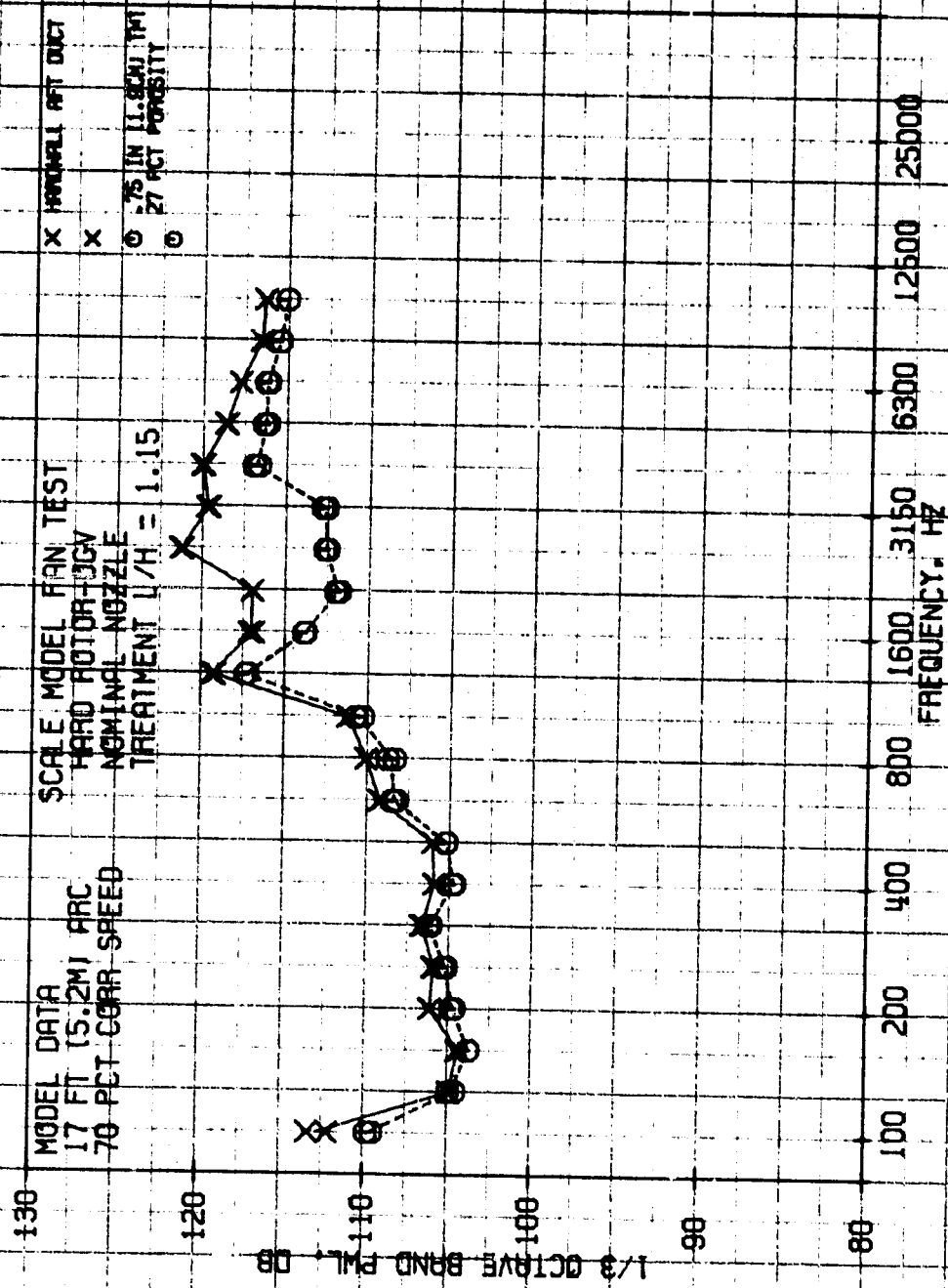


FIGURE 235

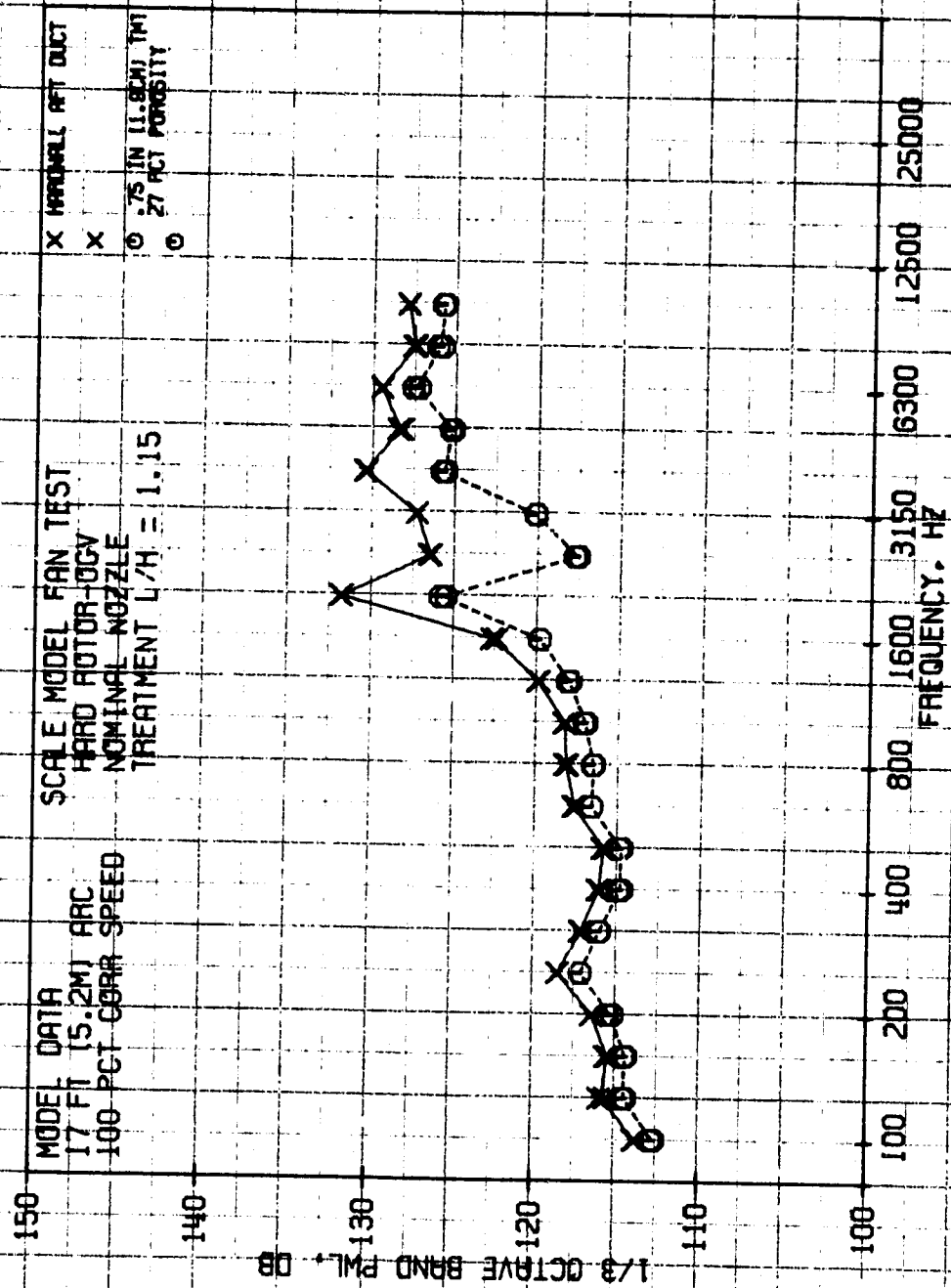


FIGURE 236

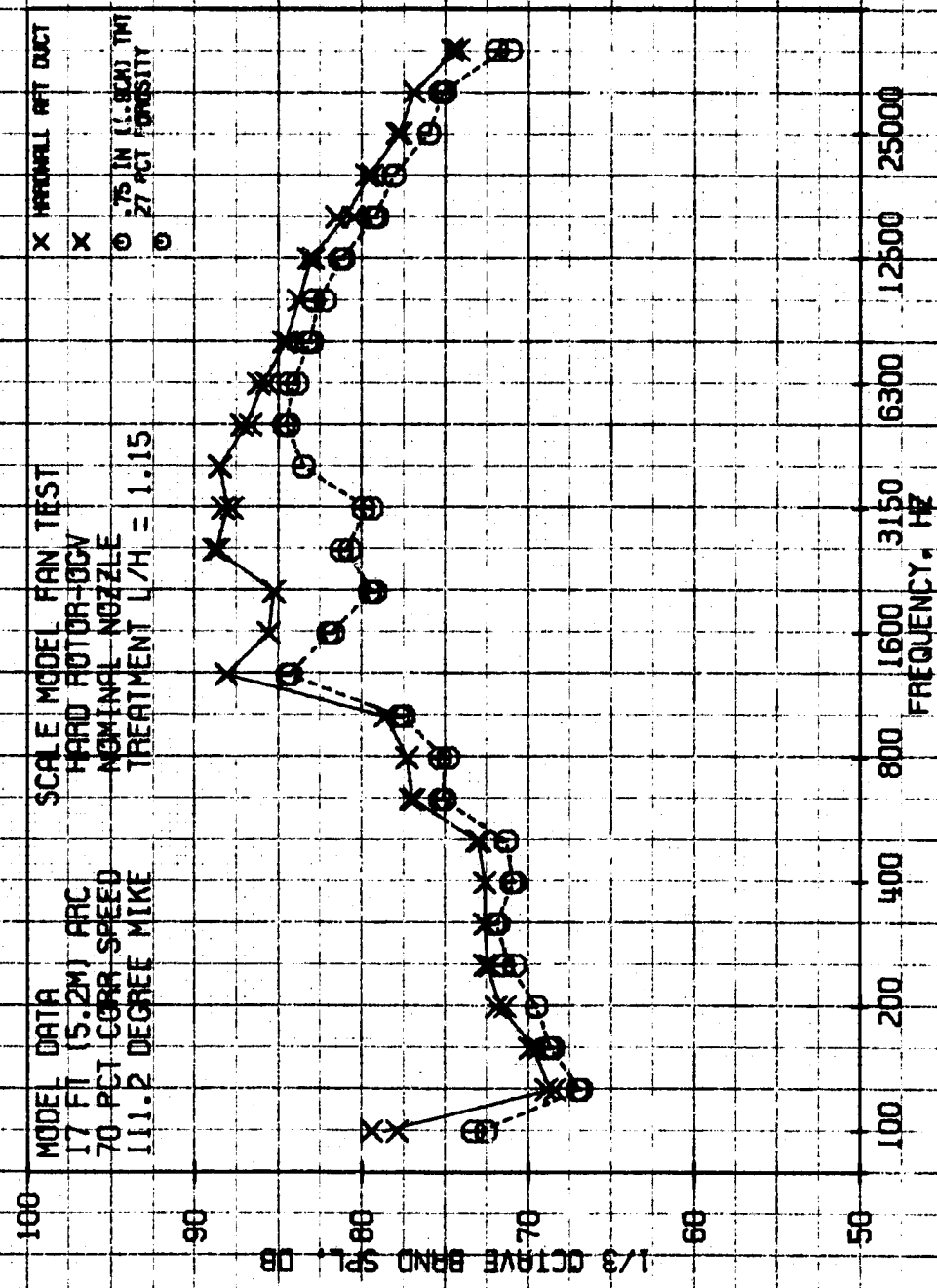


FIGURE 237

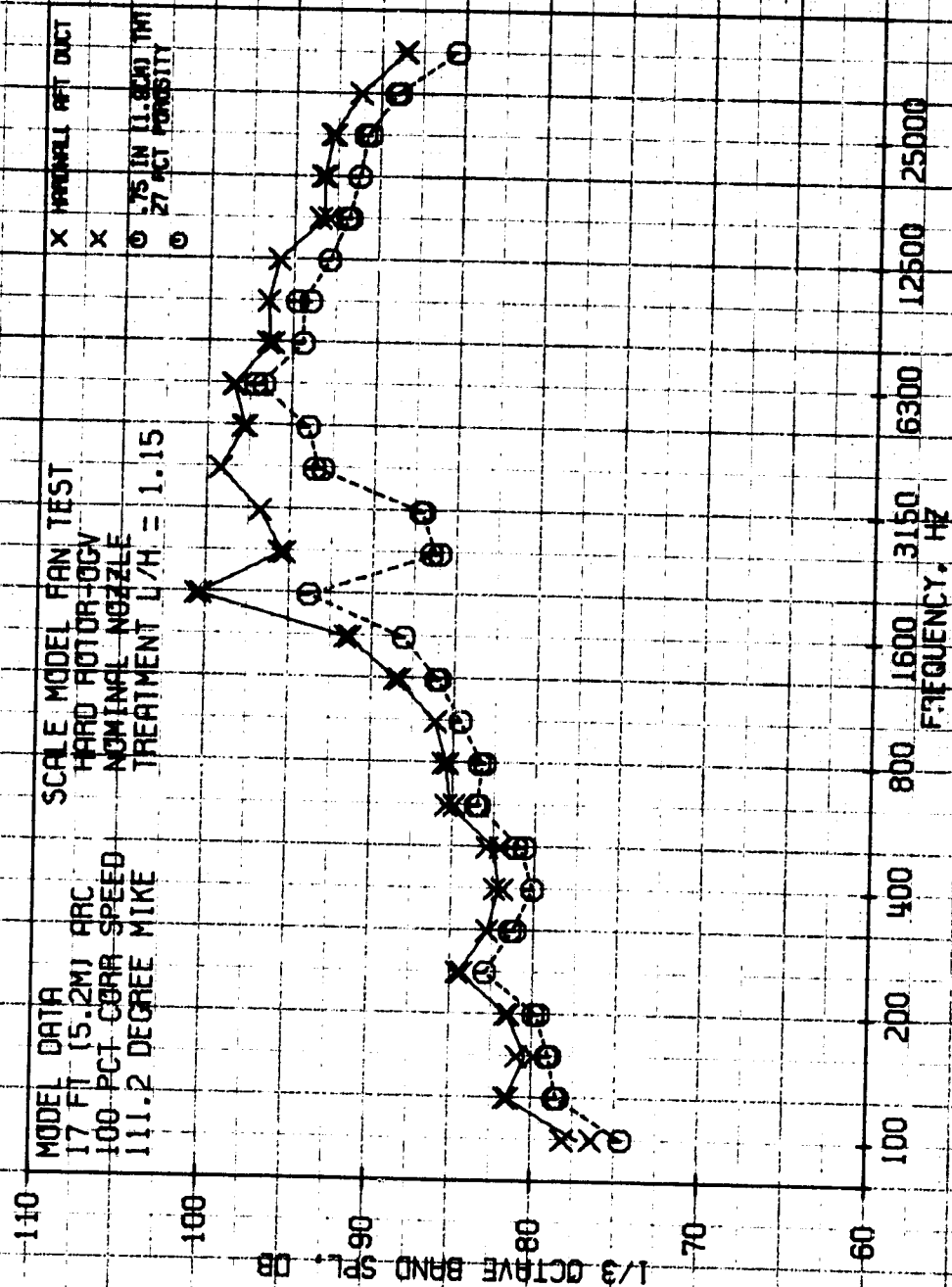


FIGURE 238

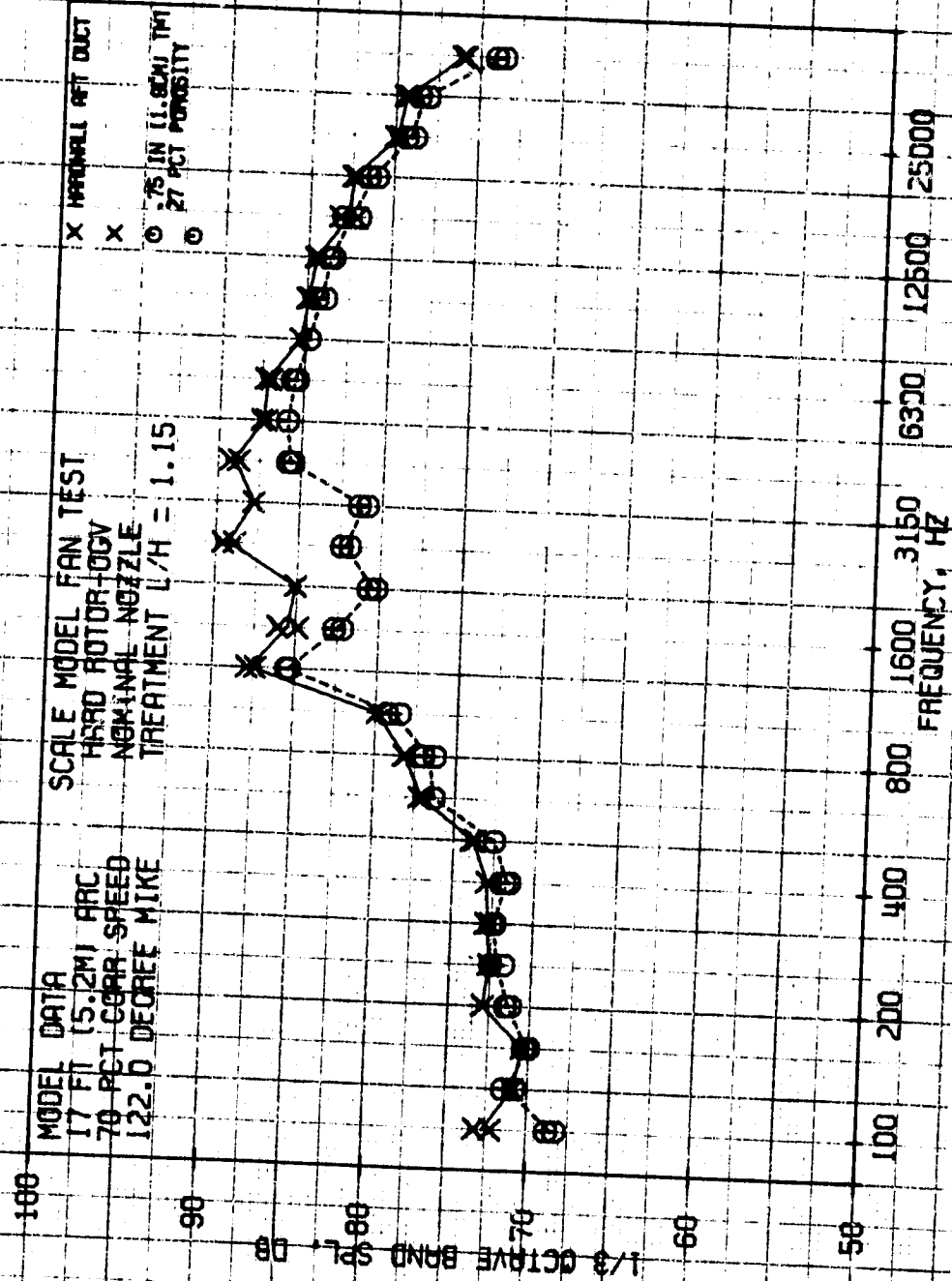


FIGURE 239

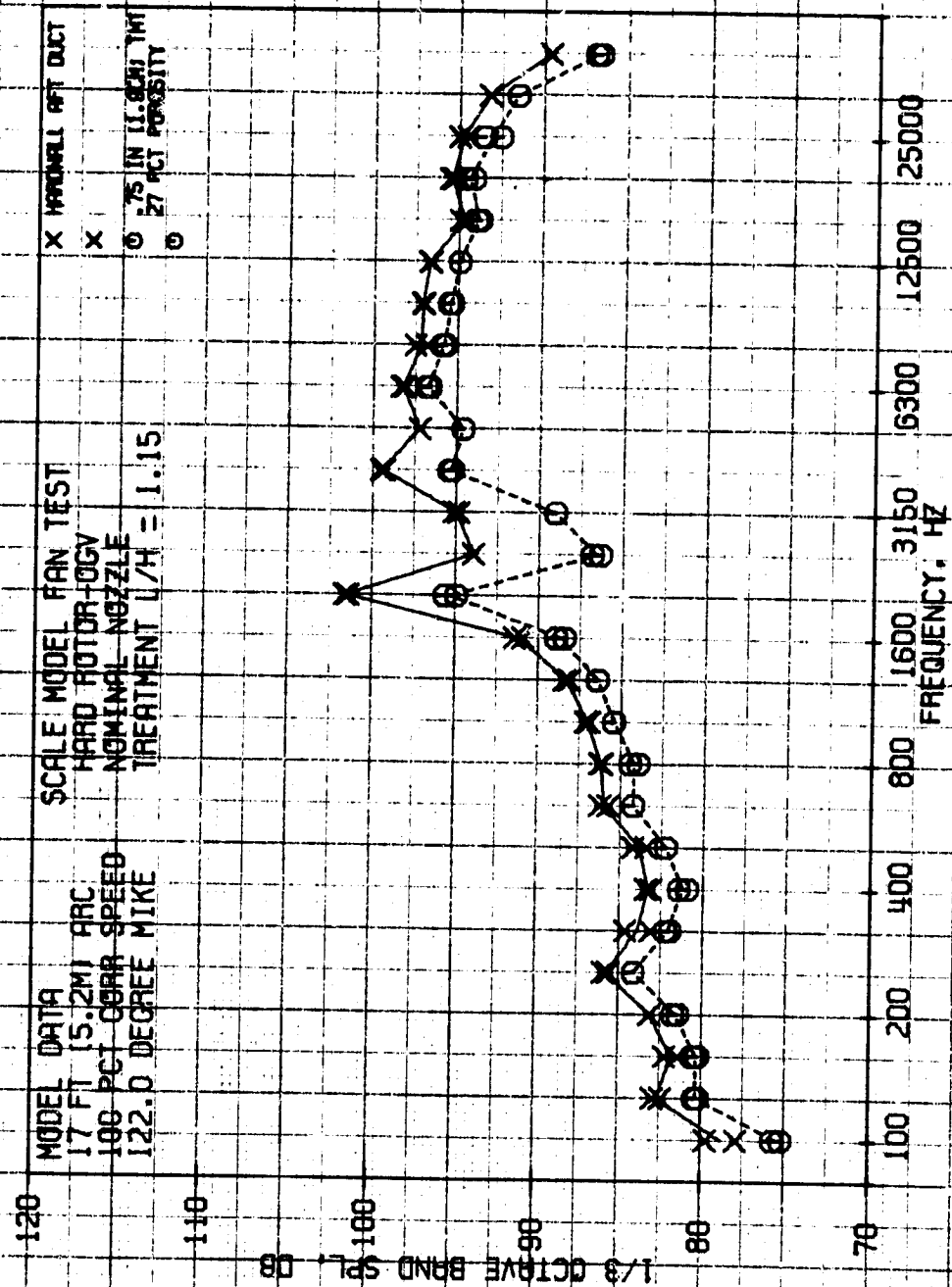
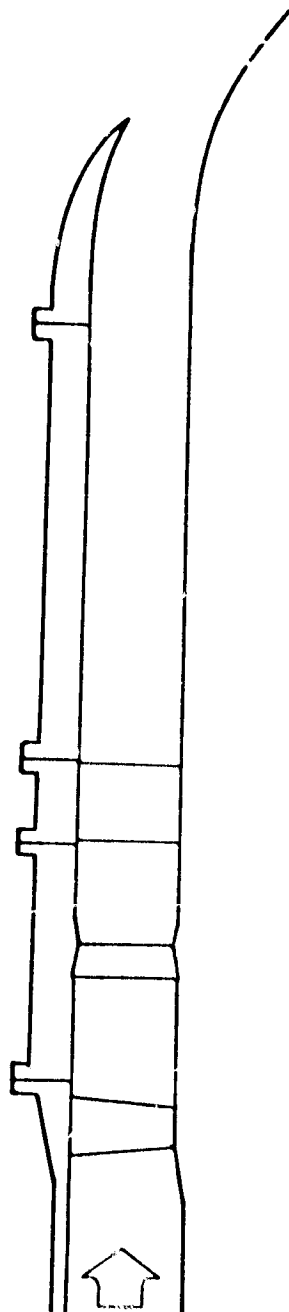


FIGURE 240

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1 J, POROSITY = 27%

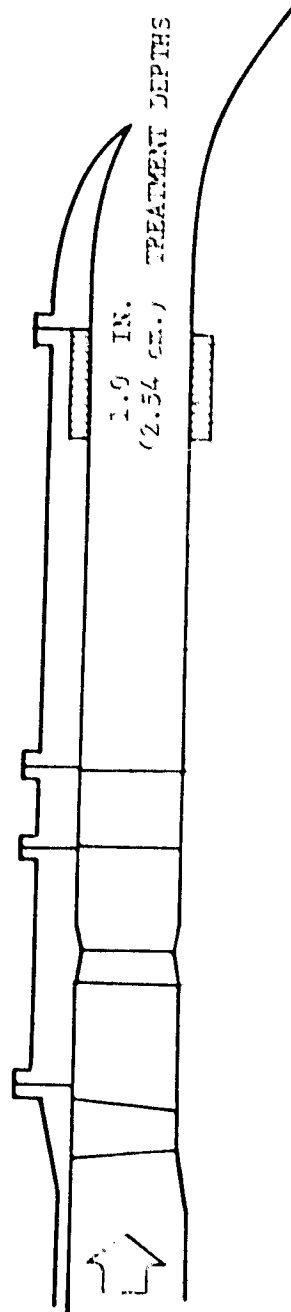


FIGURE 241.  $L/H = 1.15$ , 27 PERCENT POROSITY, 1.9 INCH (2.54 CM) CONFIGURATION



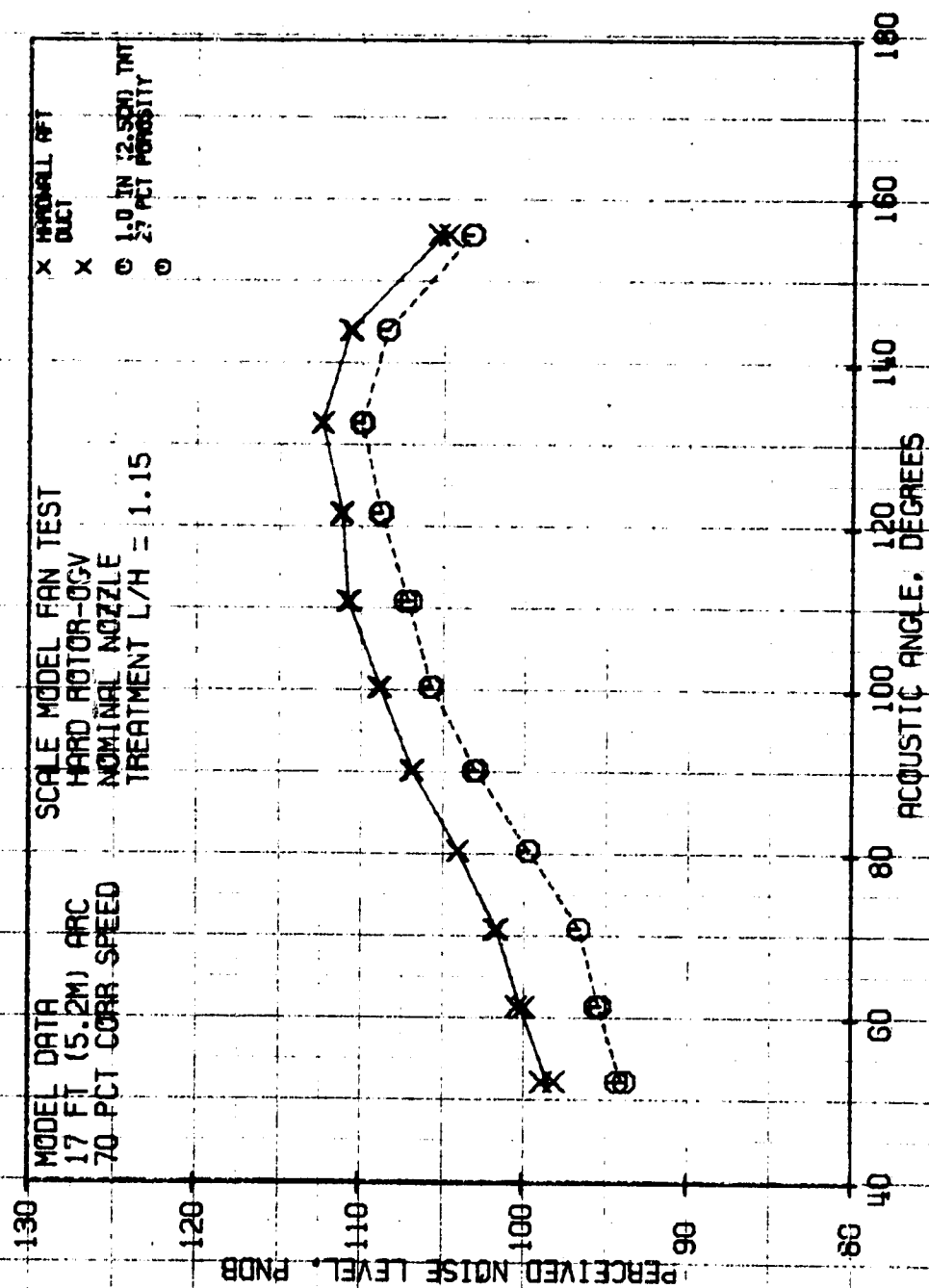


FIGURE 242

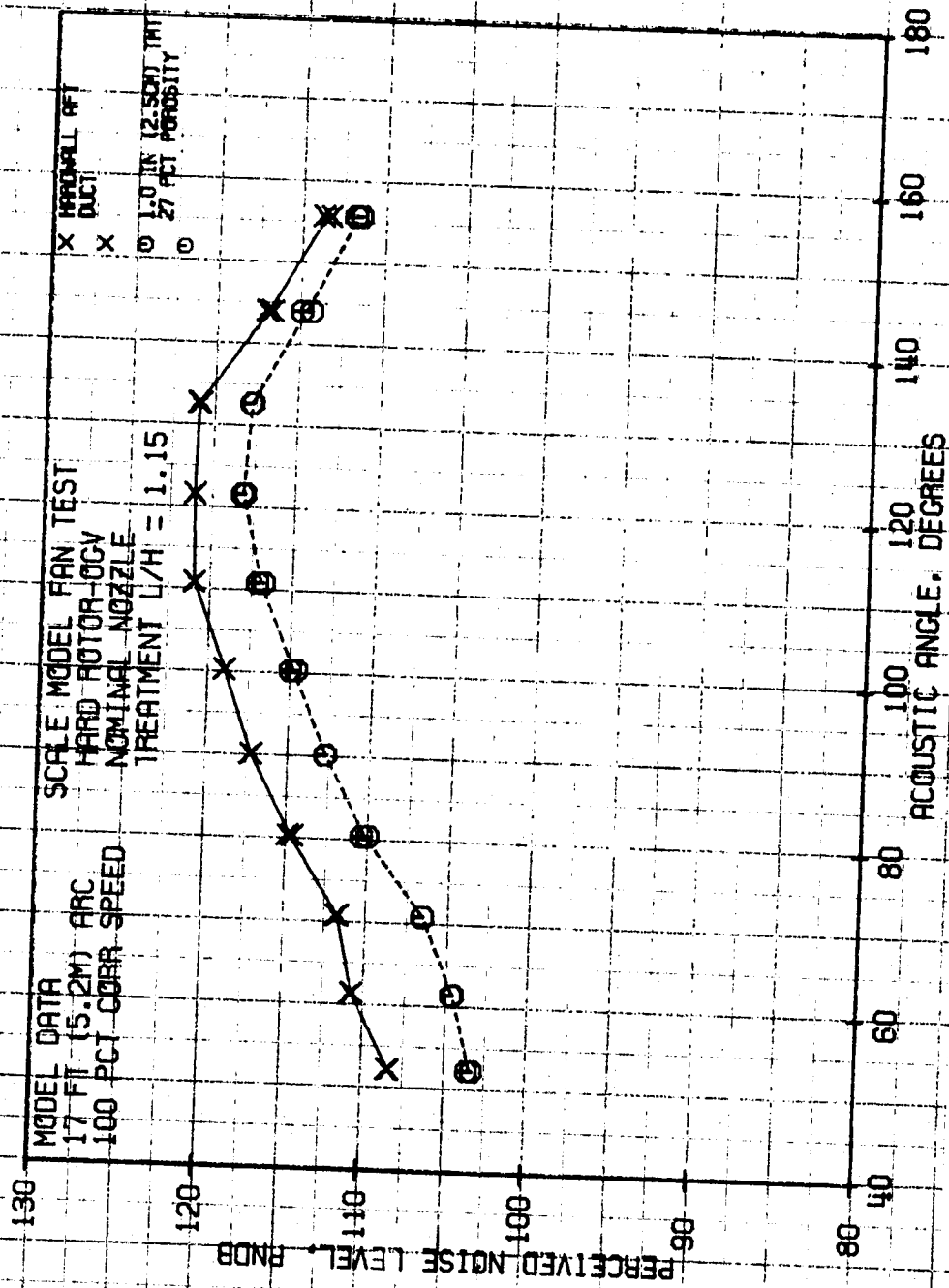


FIGURE 243

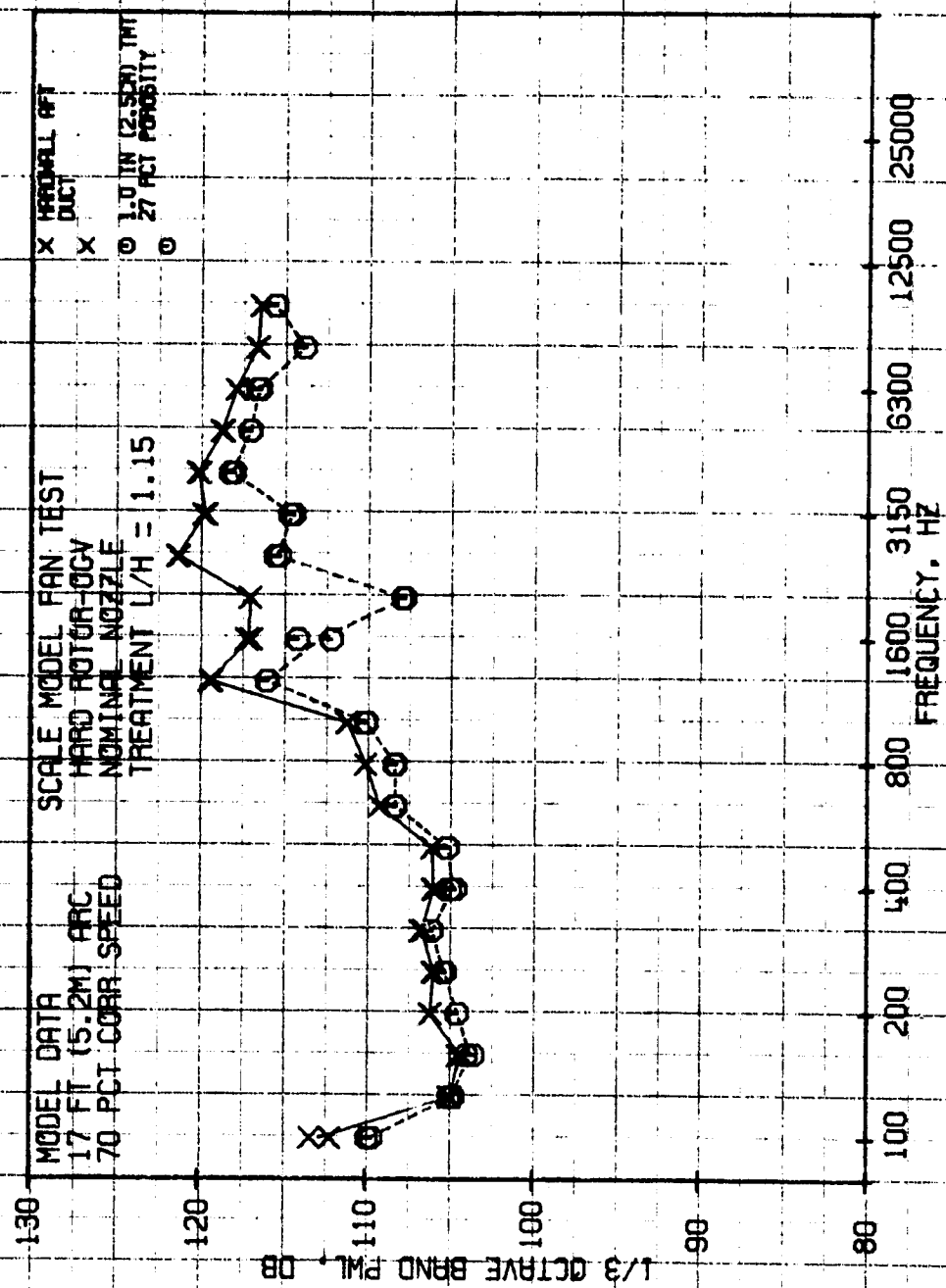


FIGURE 244

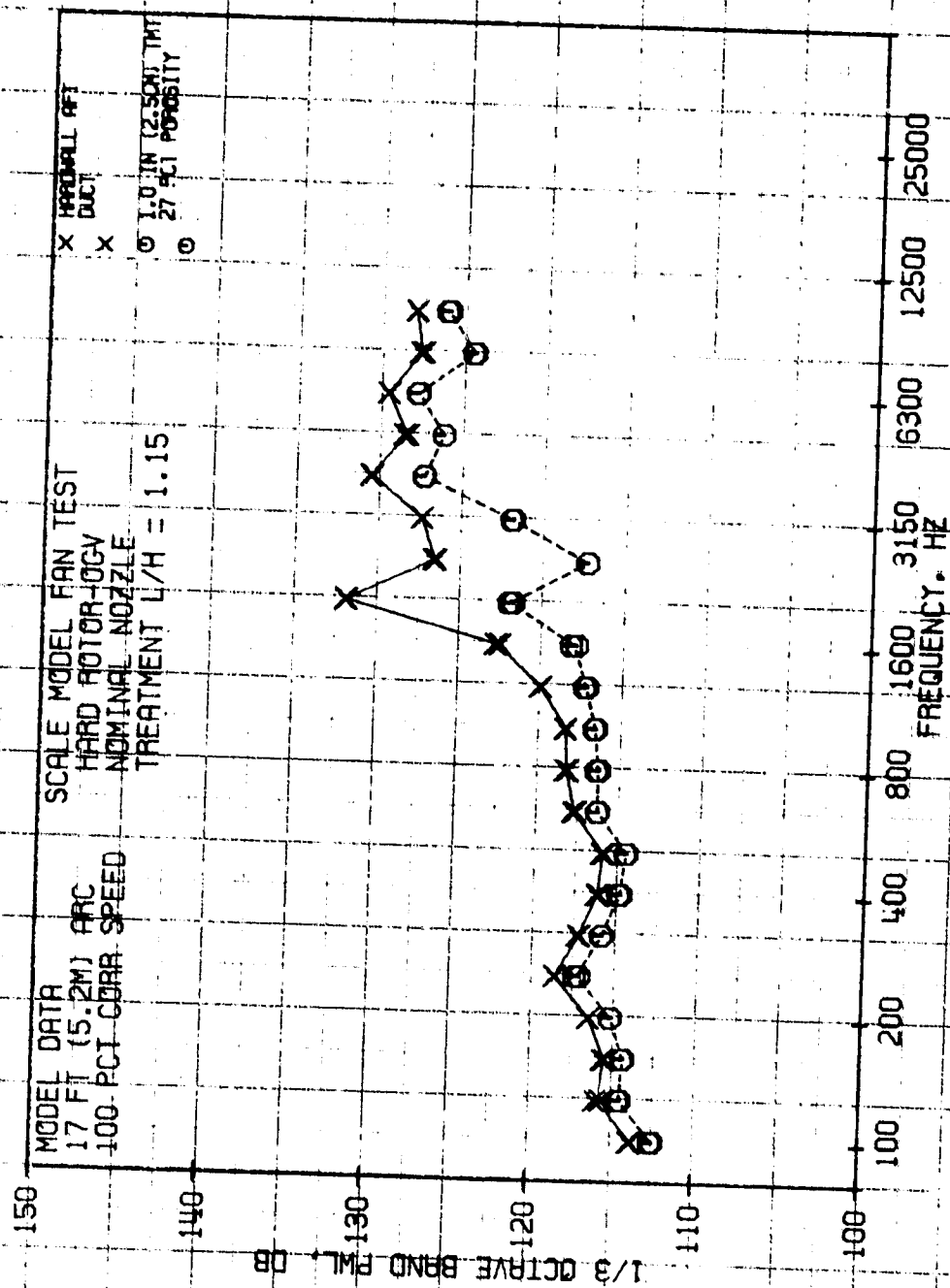


FIGURE 245

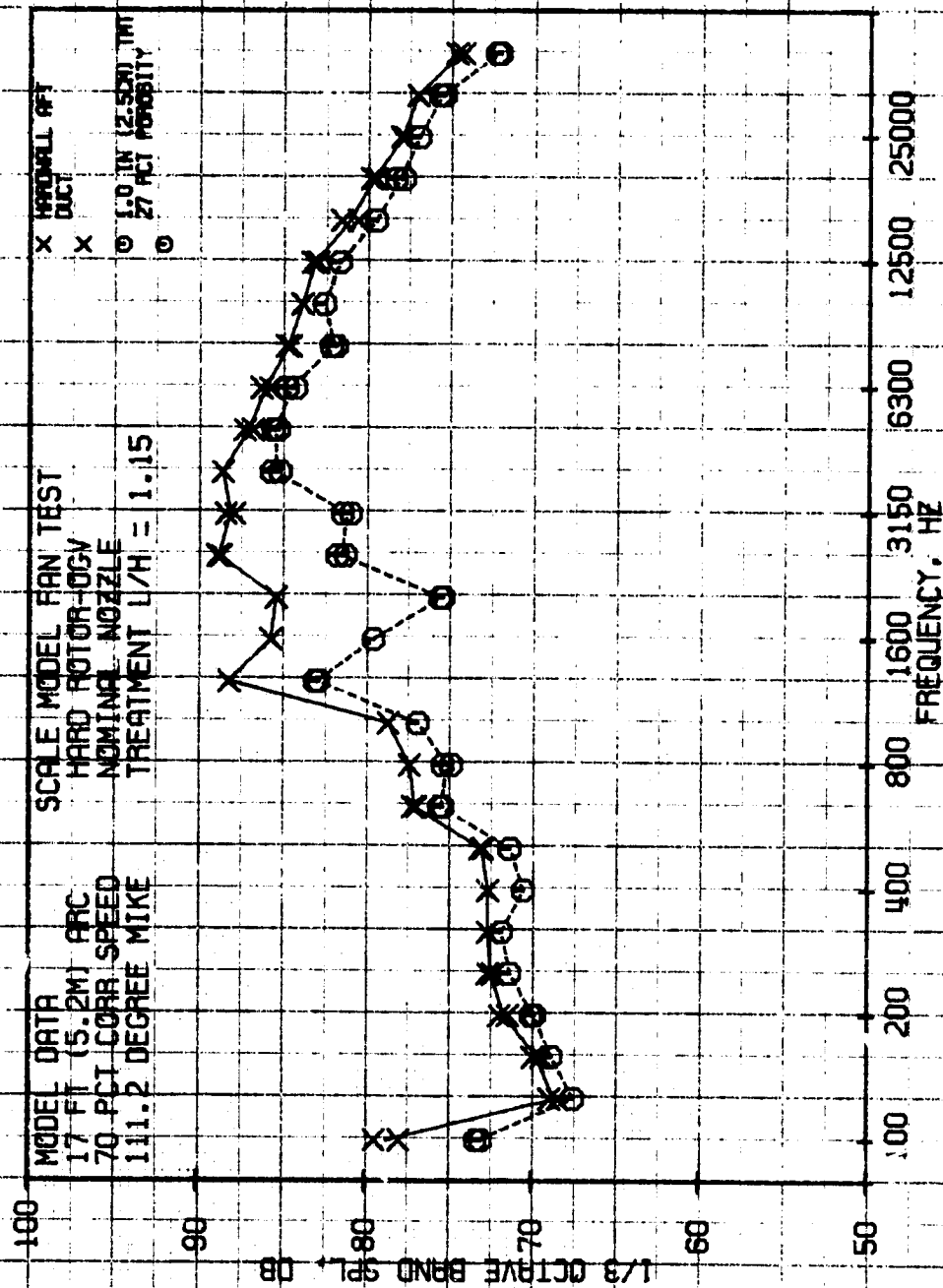


FIGURE 246

ORIGINAL PAGE IS  
POOR QUALITY

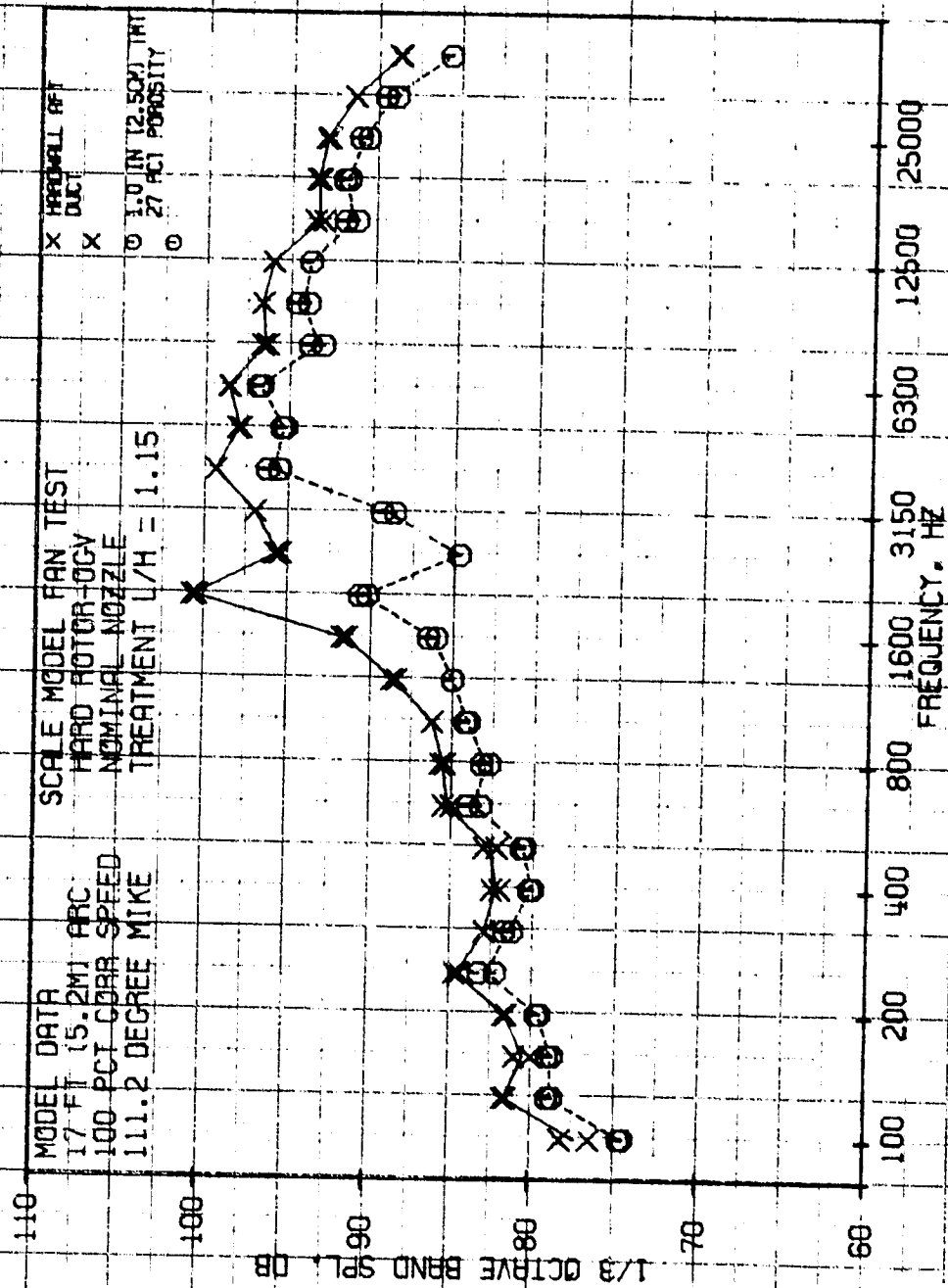


FIGURE 247

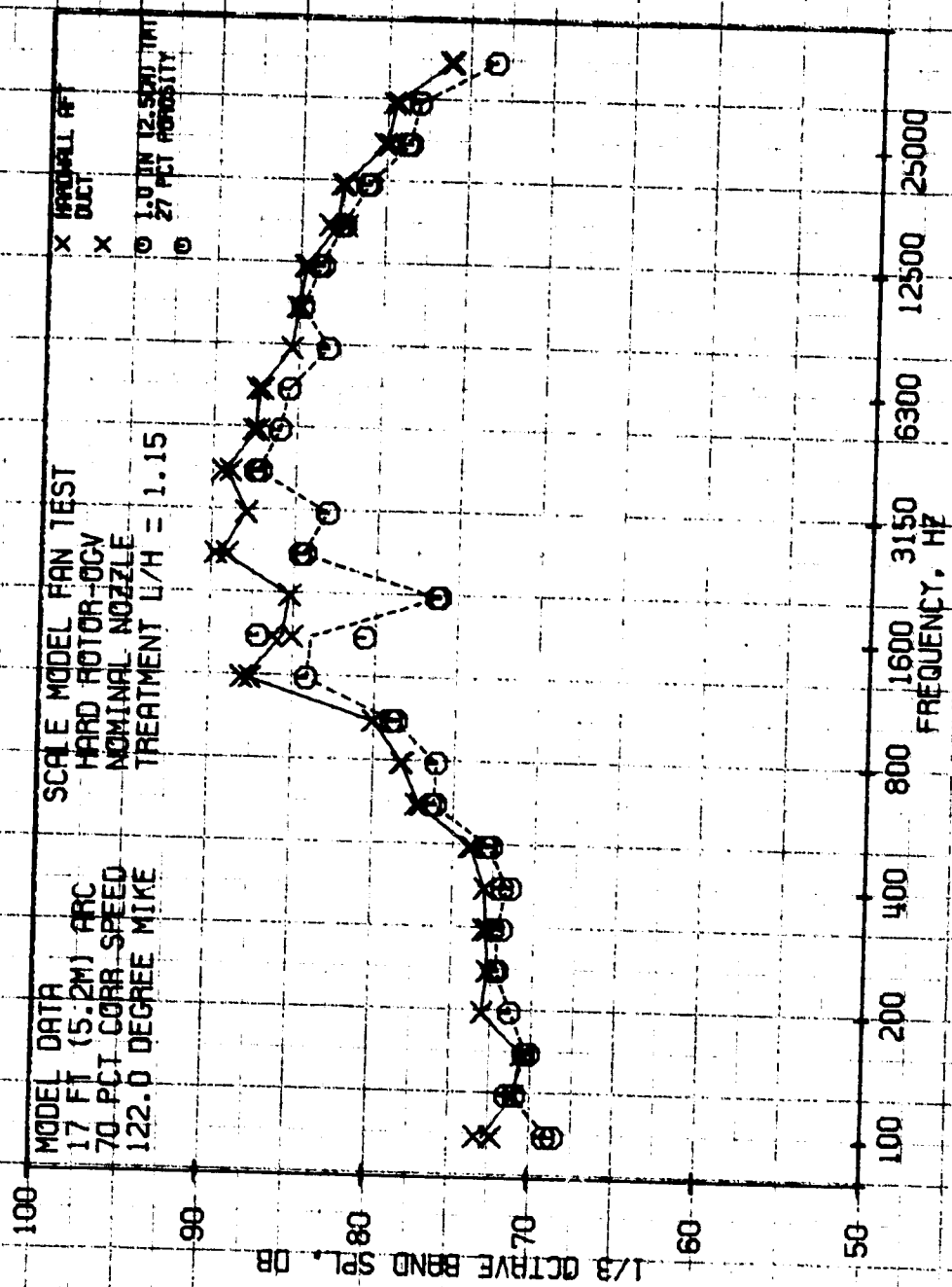


FIGURE 248

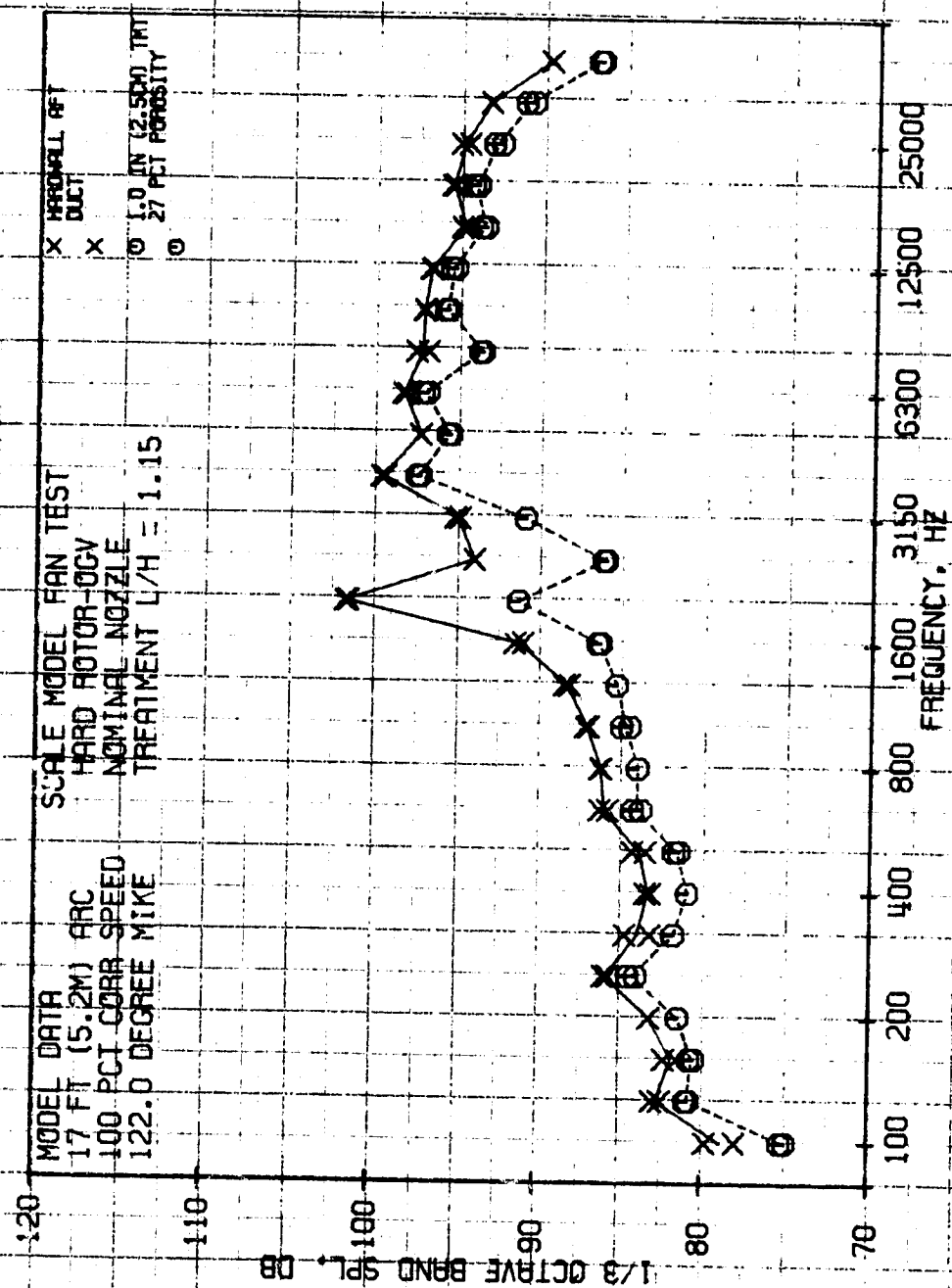
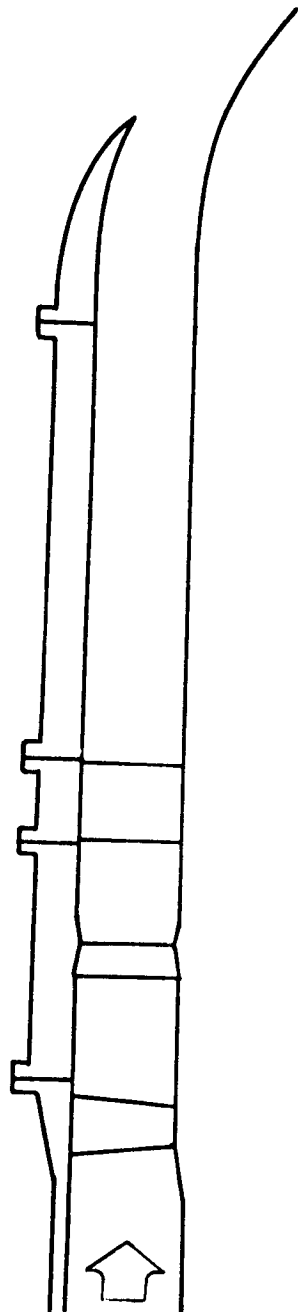


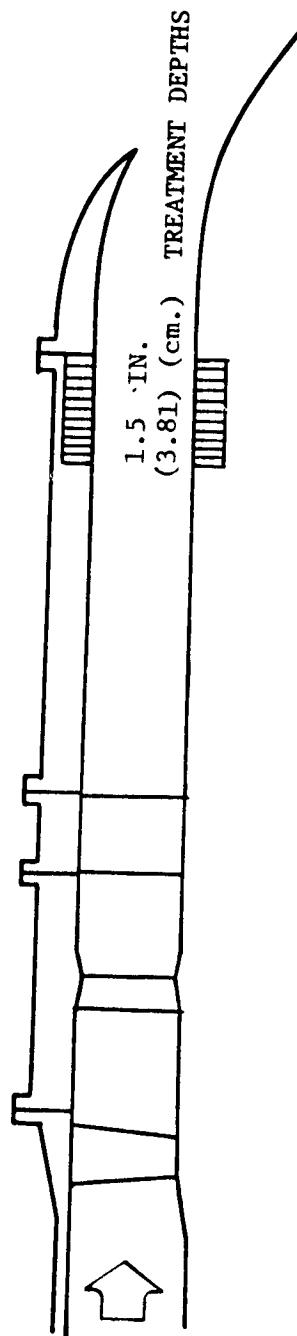
FIGURE 249



CONFIGURATION 18, HARDWALL



CONFIGURATION 75-1 K, POROSITY = 27%

FIGURE 250.  $L/H = 1.15$ , 27 PERCENT POROSITY, 1.5 INCH (3.81 cm) CONFIGURATION

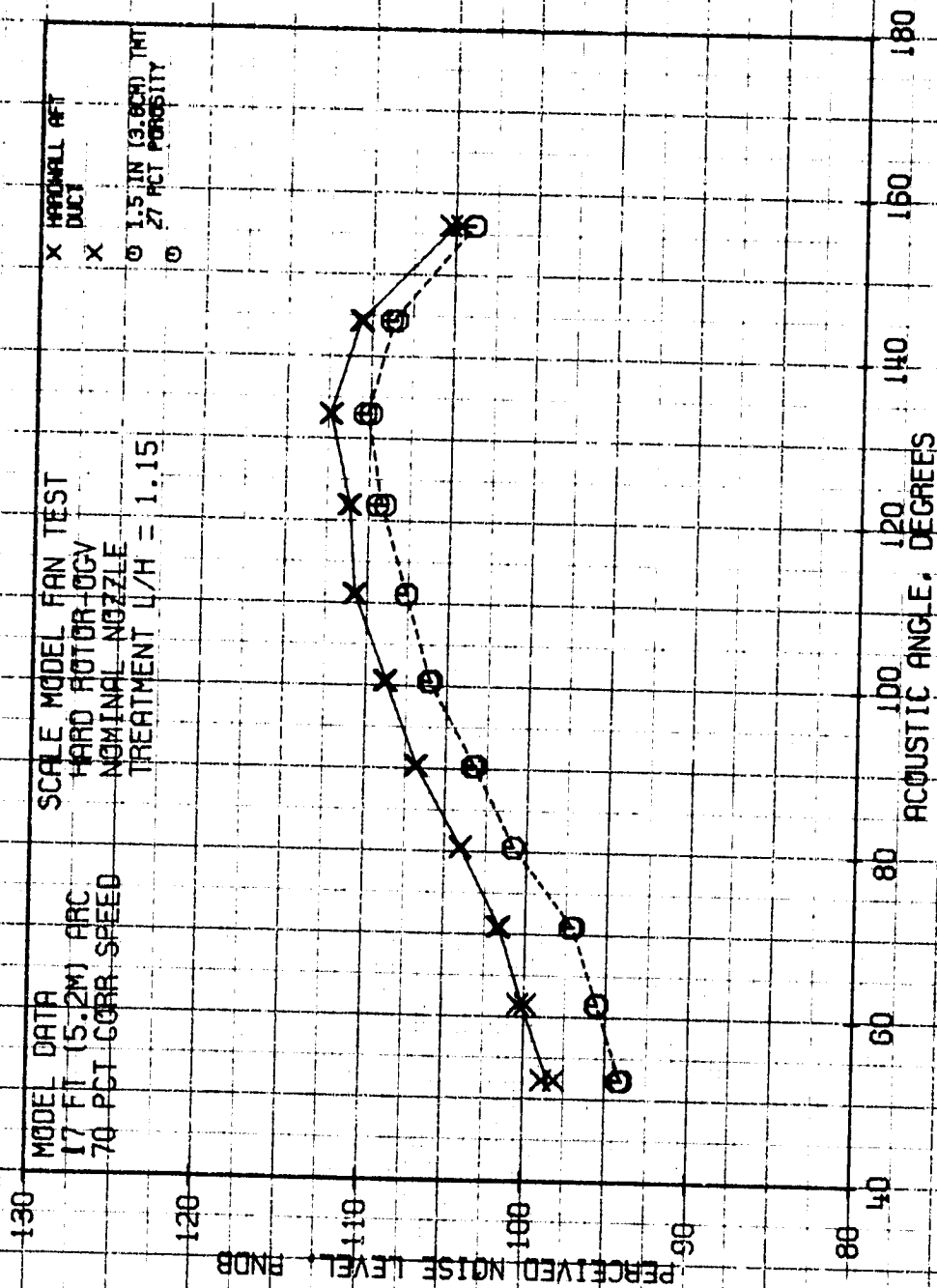


FIGURE 251

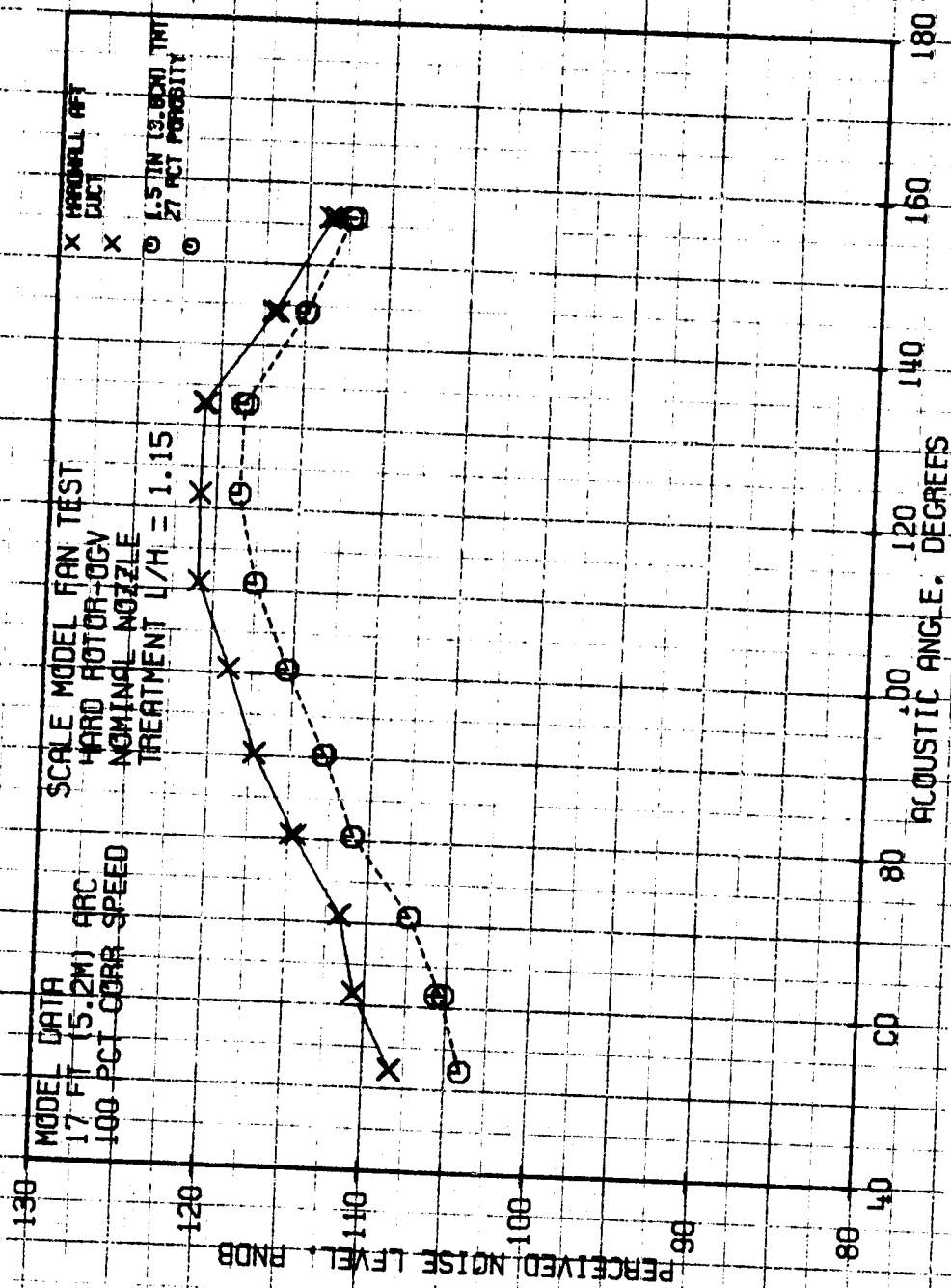


FIGURE 252

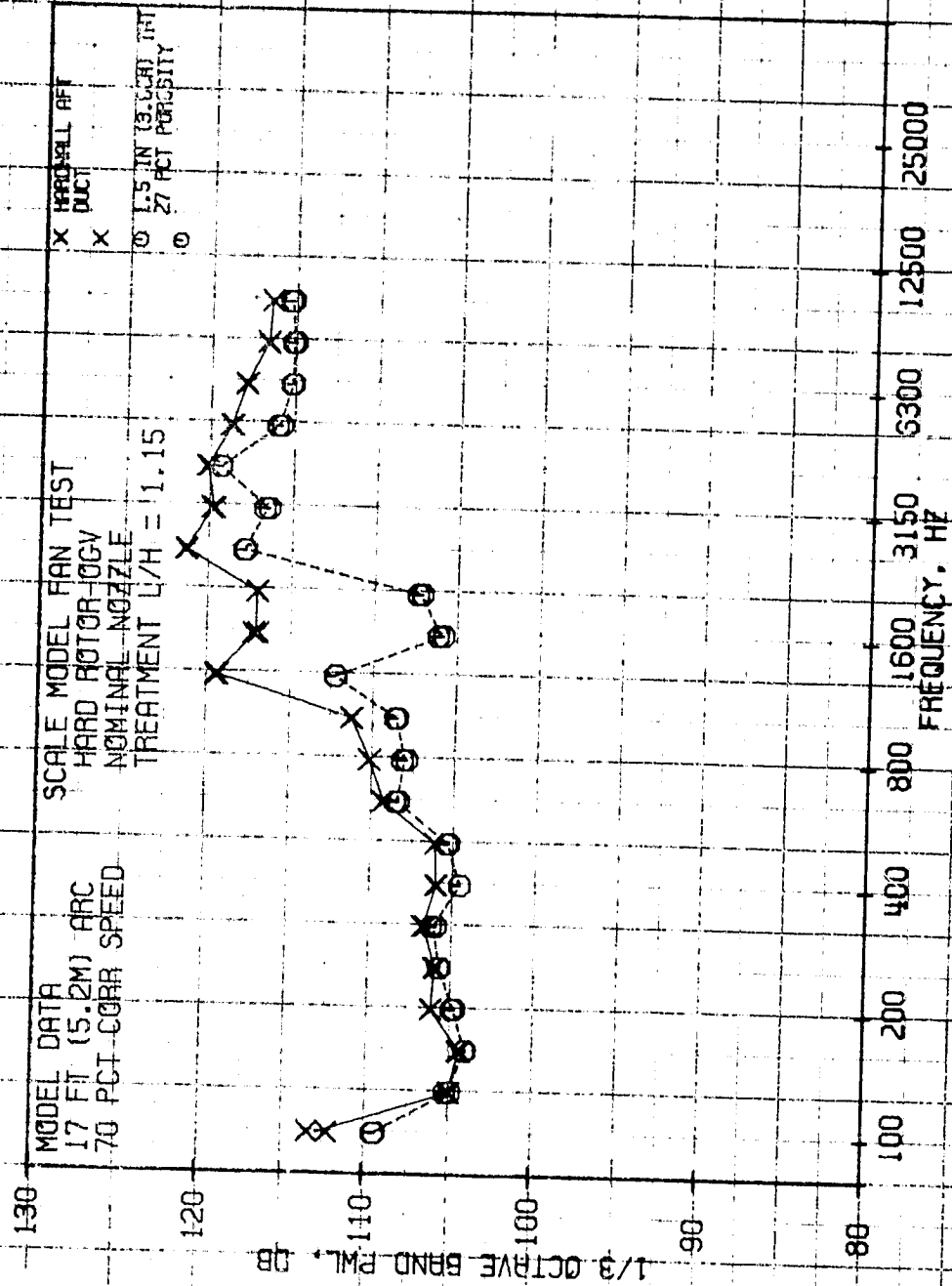


FIGURE 253

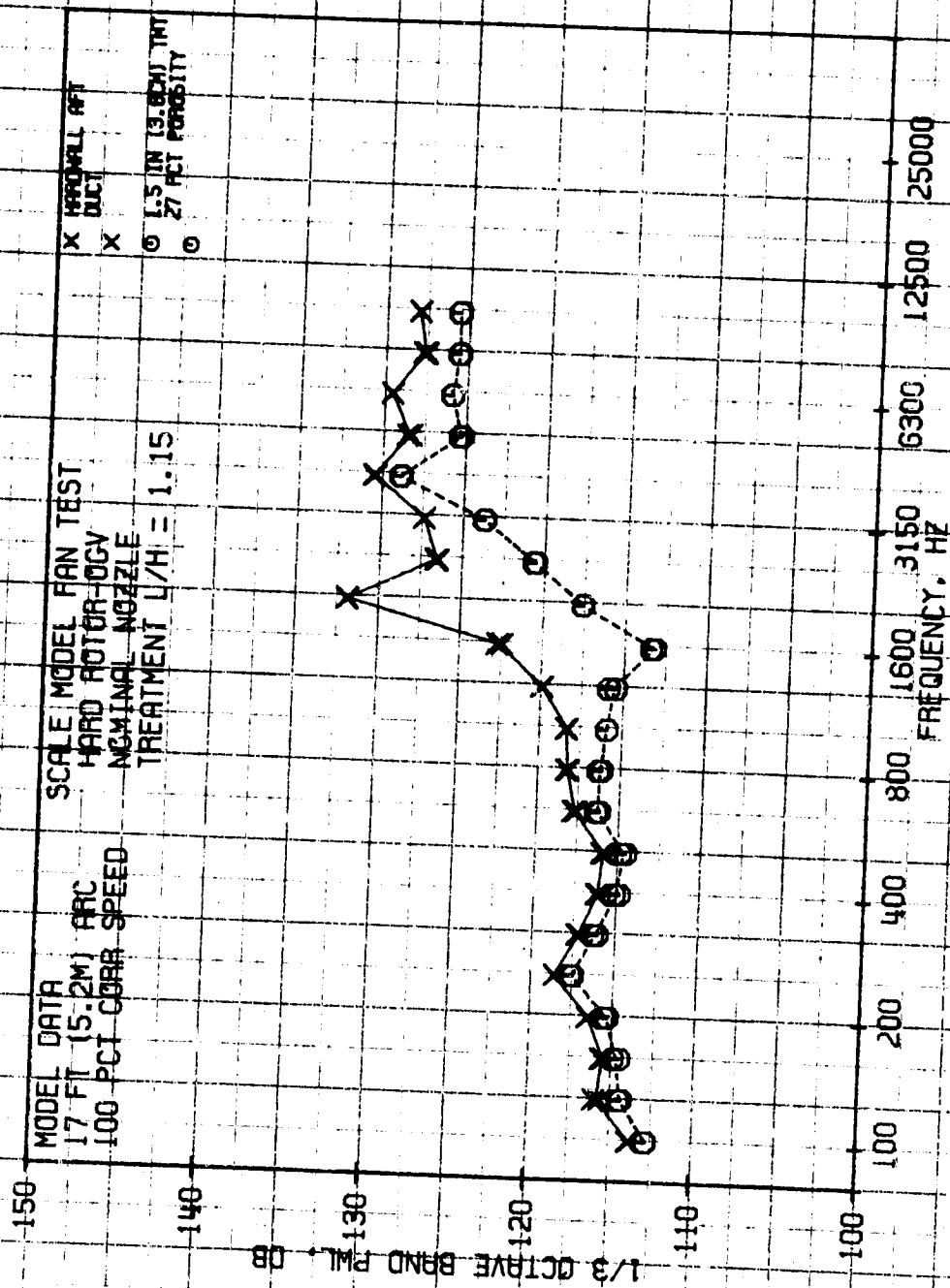


FIGURE 254

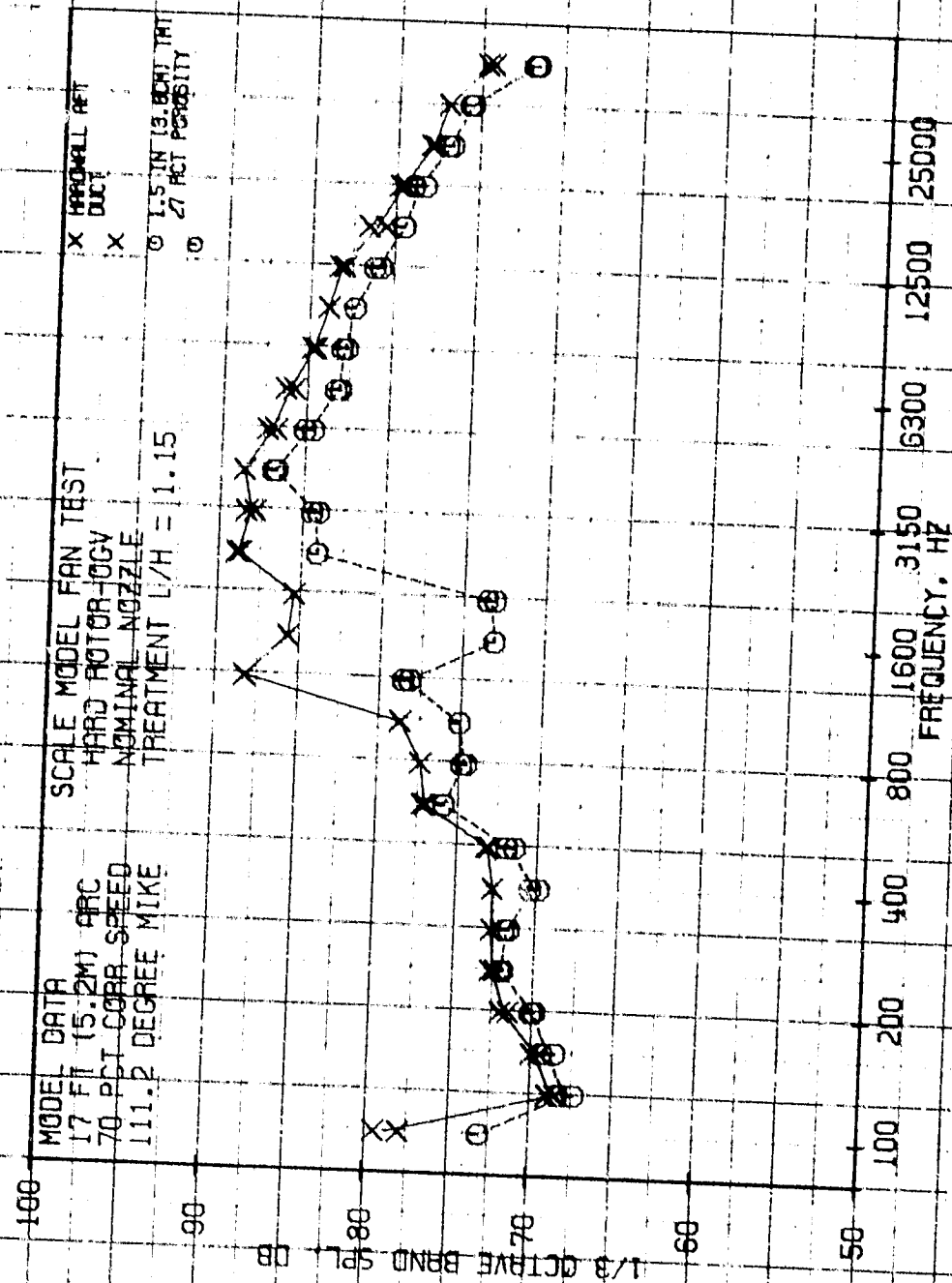


FIGURE 255

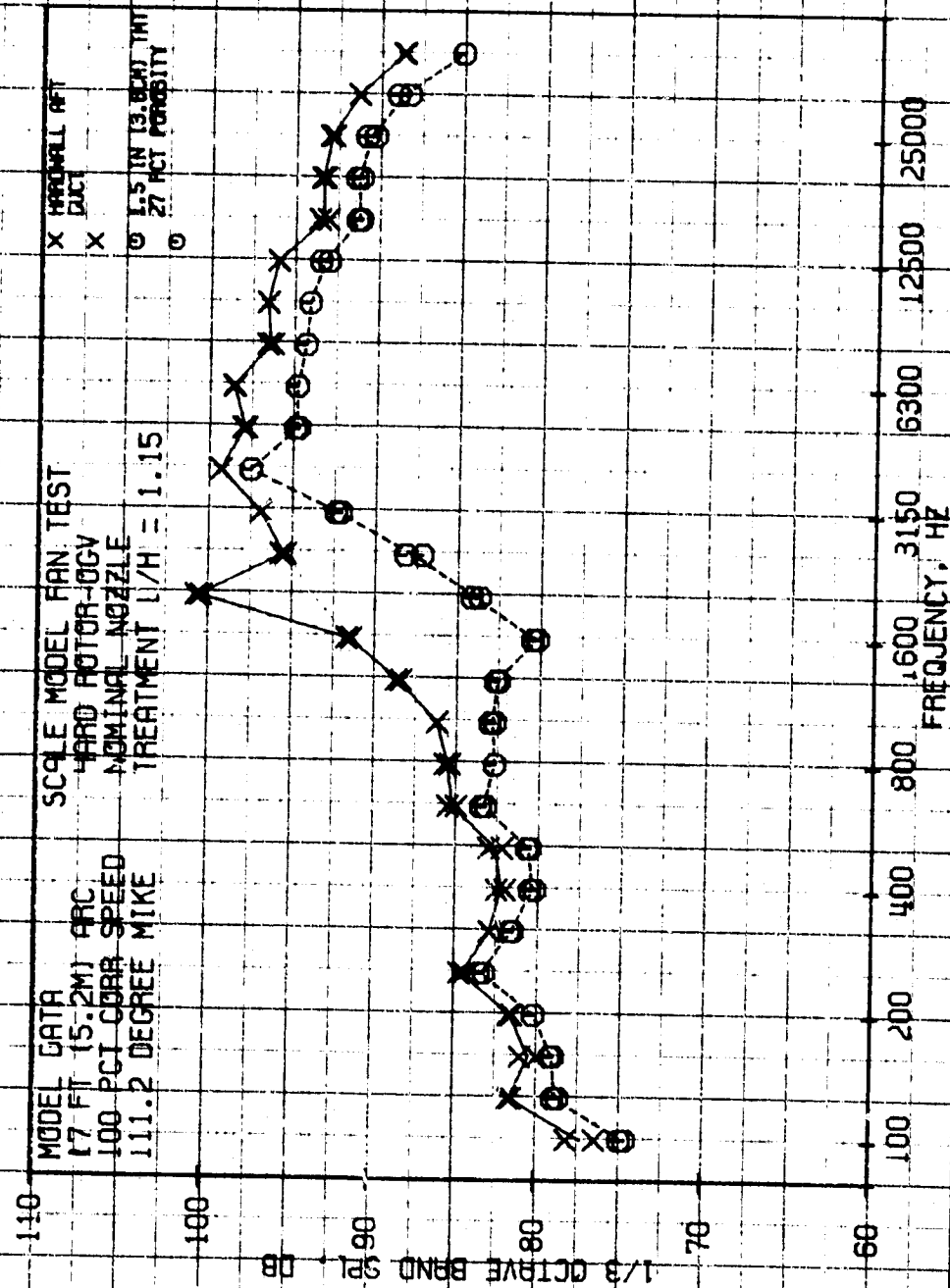


FIGURE 256

ORIGINAL PAGE IS  
OF POOR QUALITY

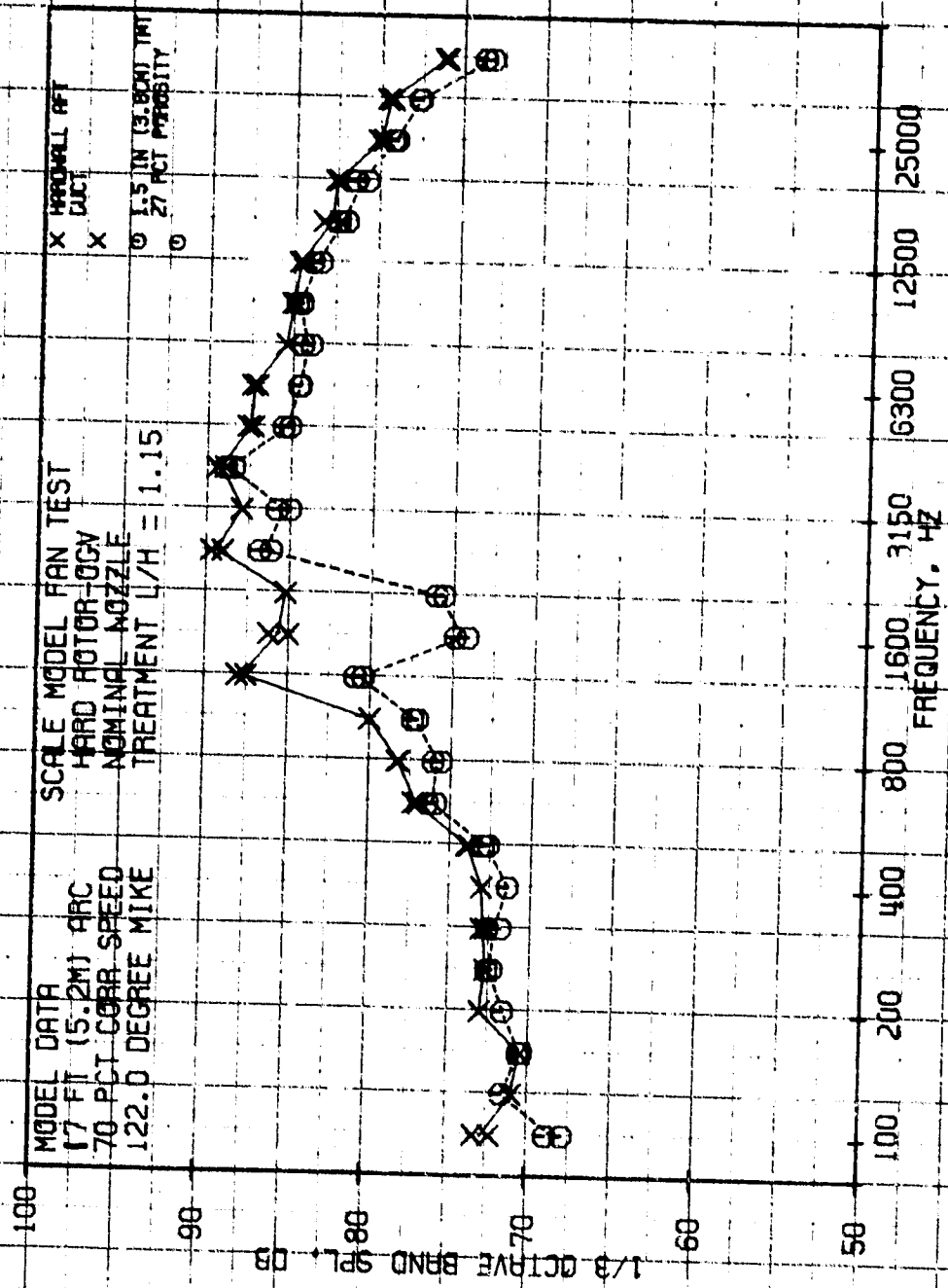


FIGURE 257



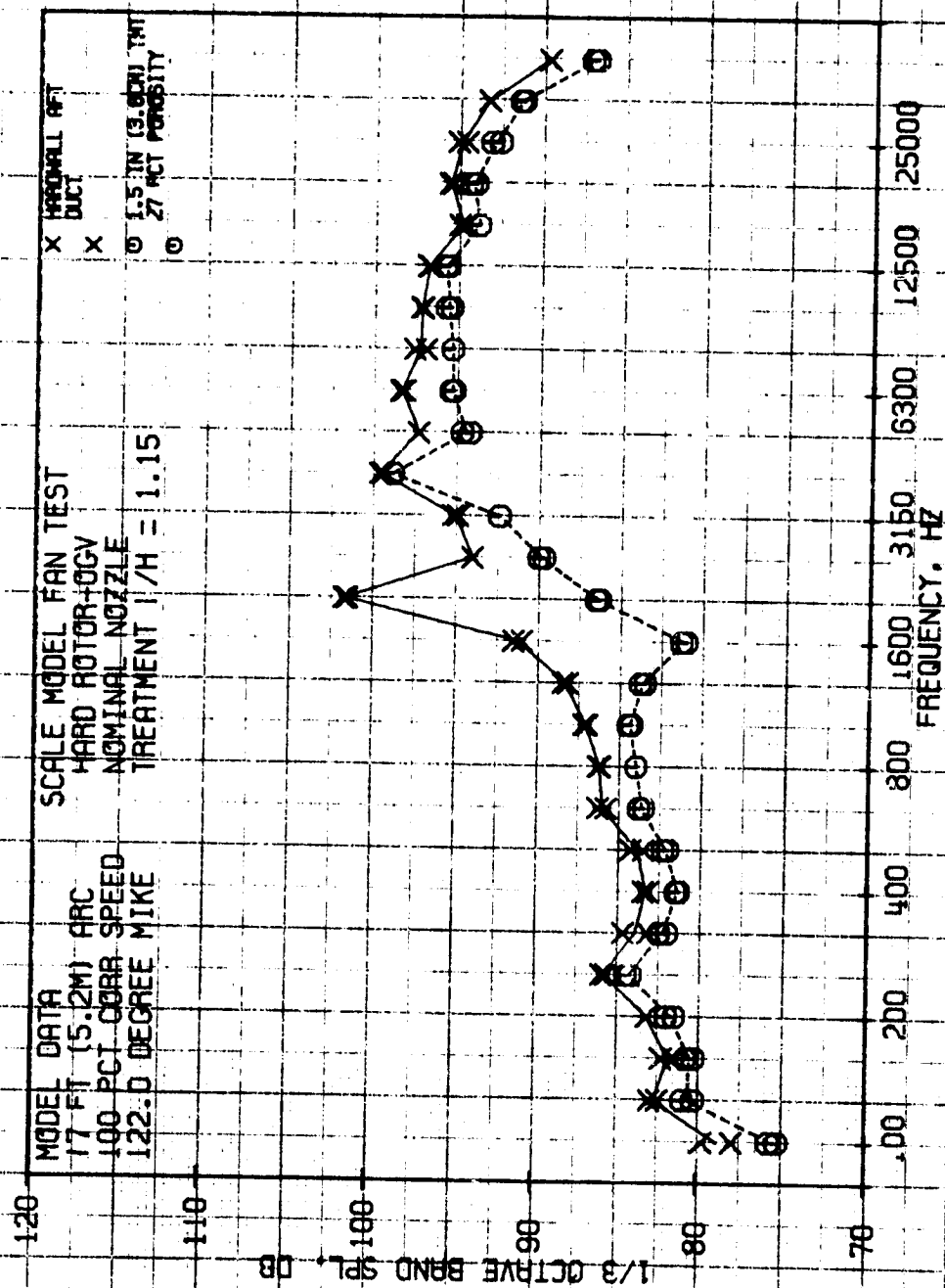
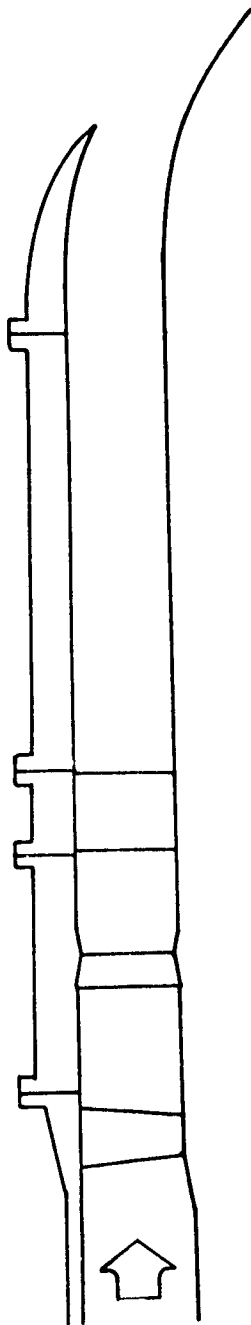


FIGURE 258

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-3, 12 PERCENT POROSITY, CONSTANT THICKNESS

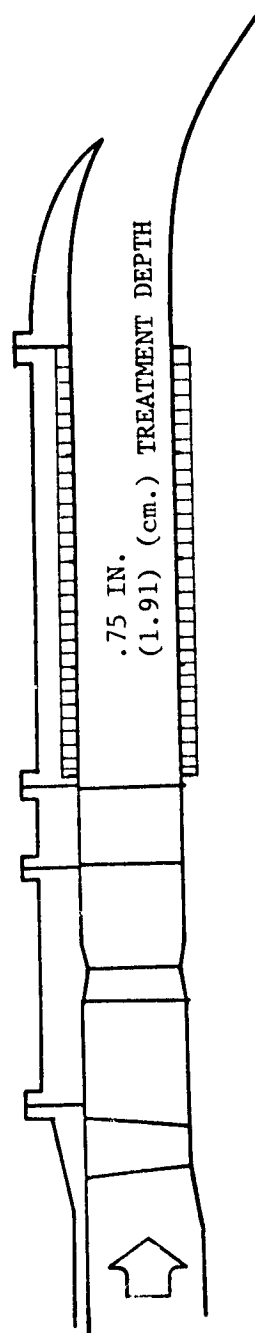


FIGURE 259 12 PERCENT POROSITY, CONSTANT THICKNESS CONFIGURATION

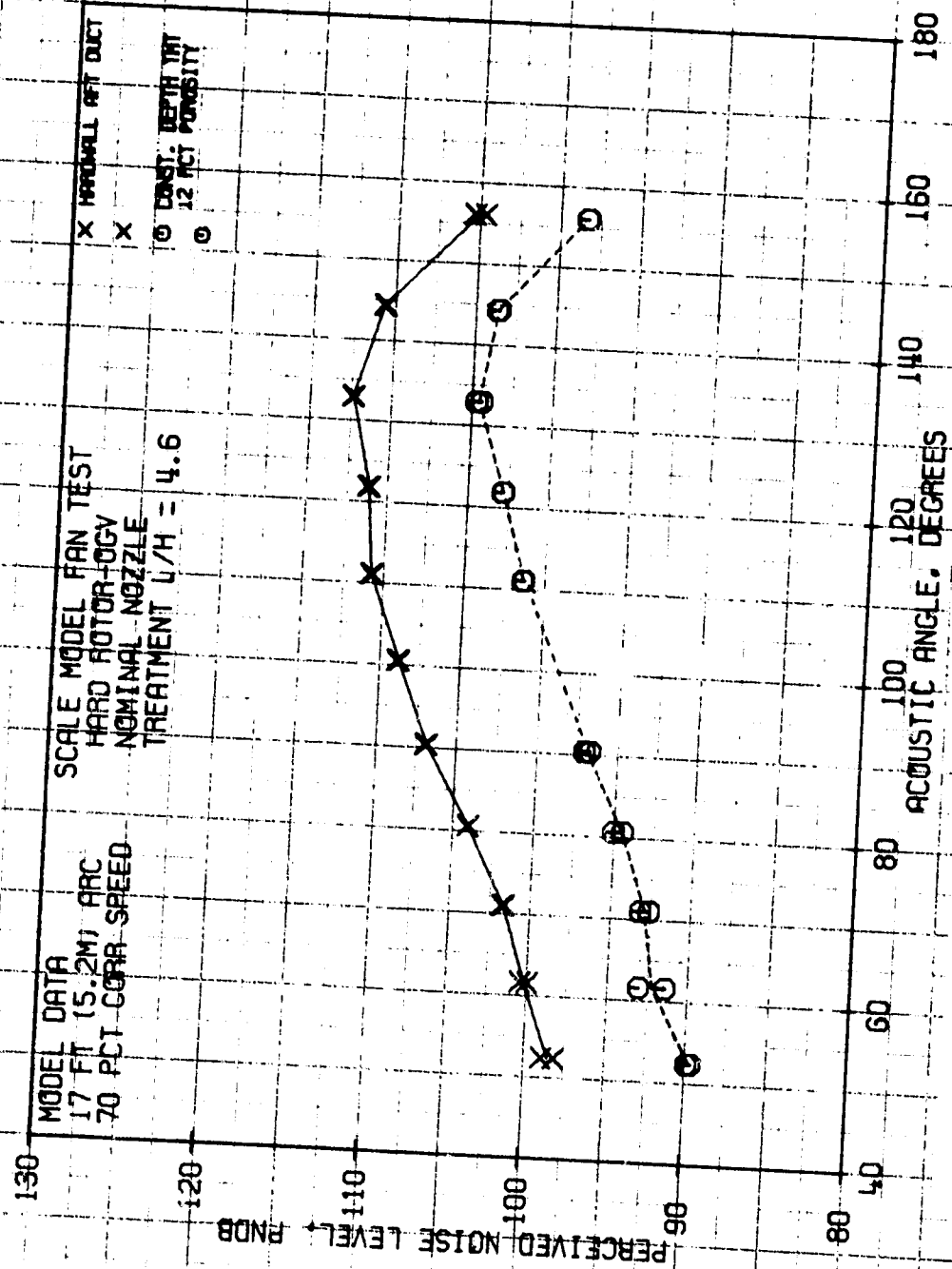


FIGURE 260

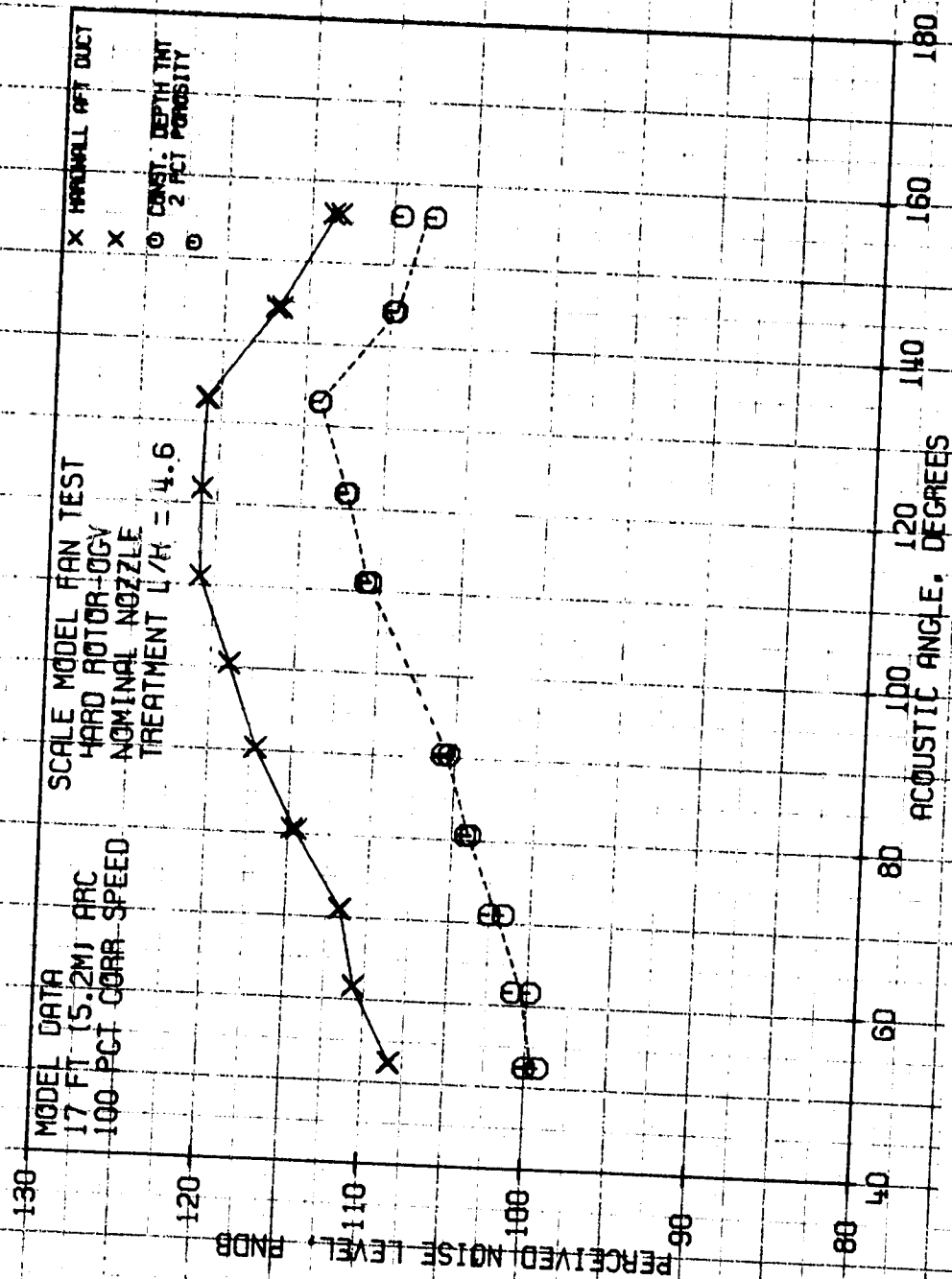


FIGURE 261

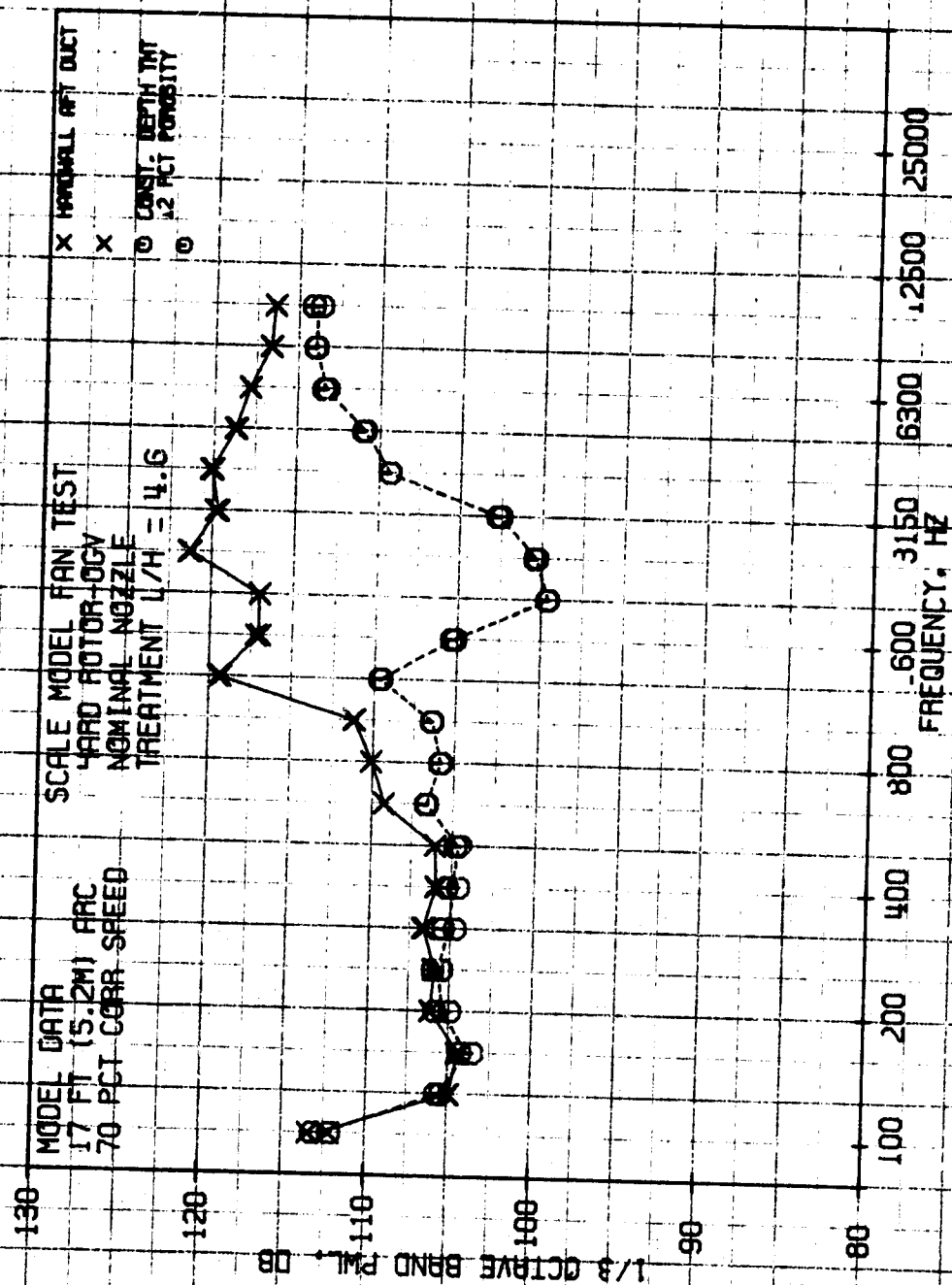


FIGURE 262

ORIGINAL PAGE IS  
OF POOR QUALITY

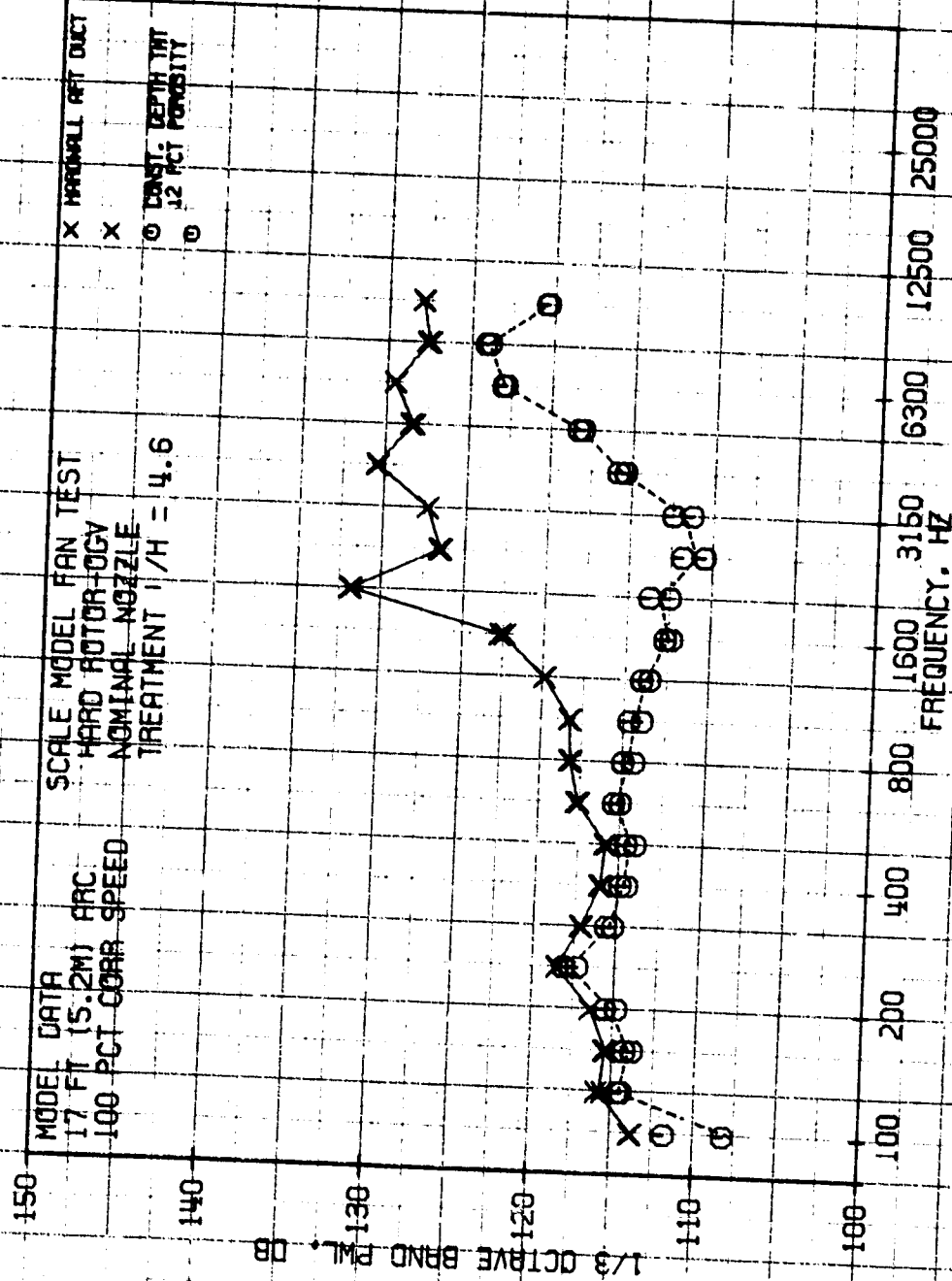


FIGURE 263

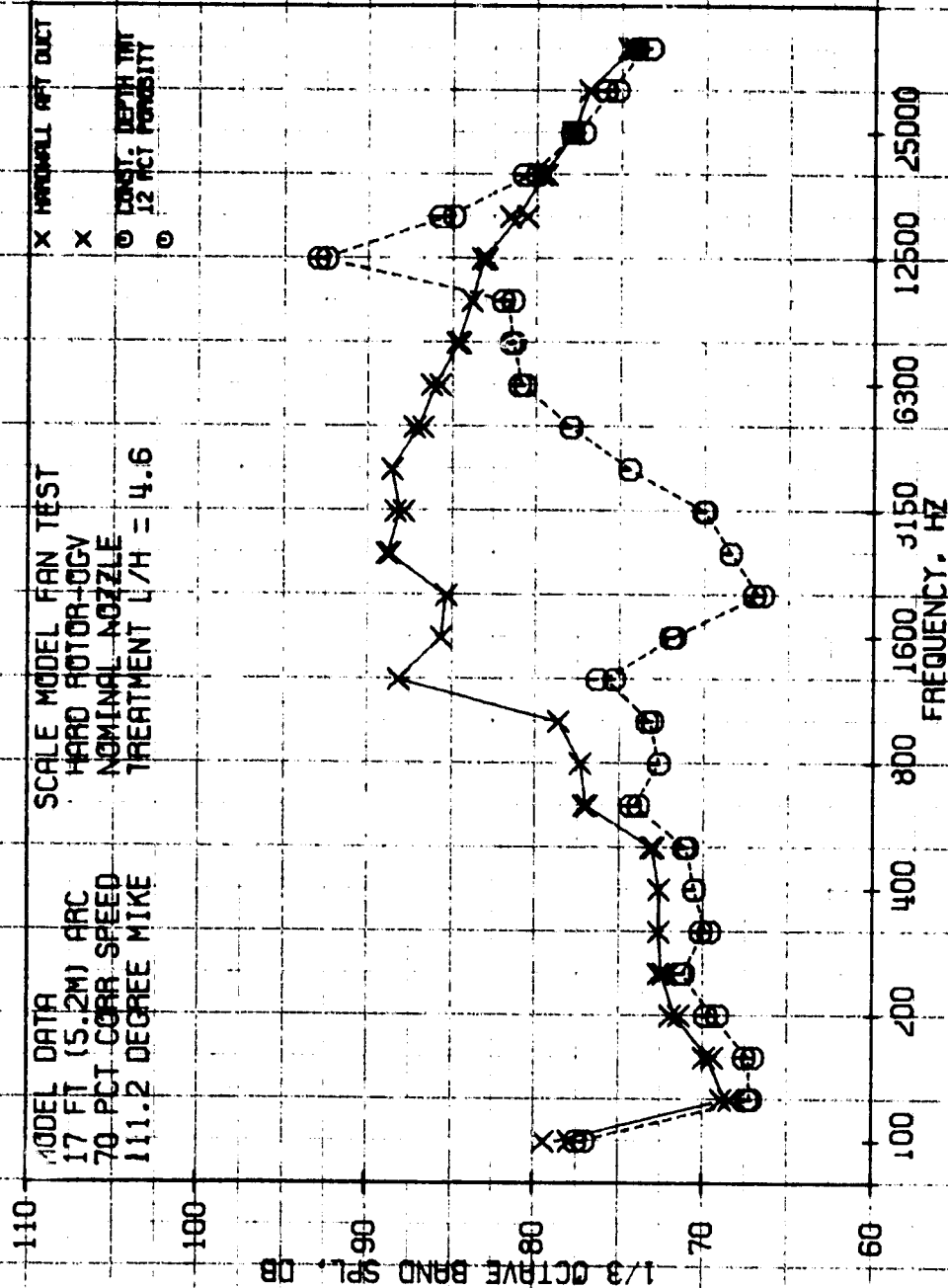


FIGURE 264

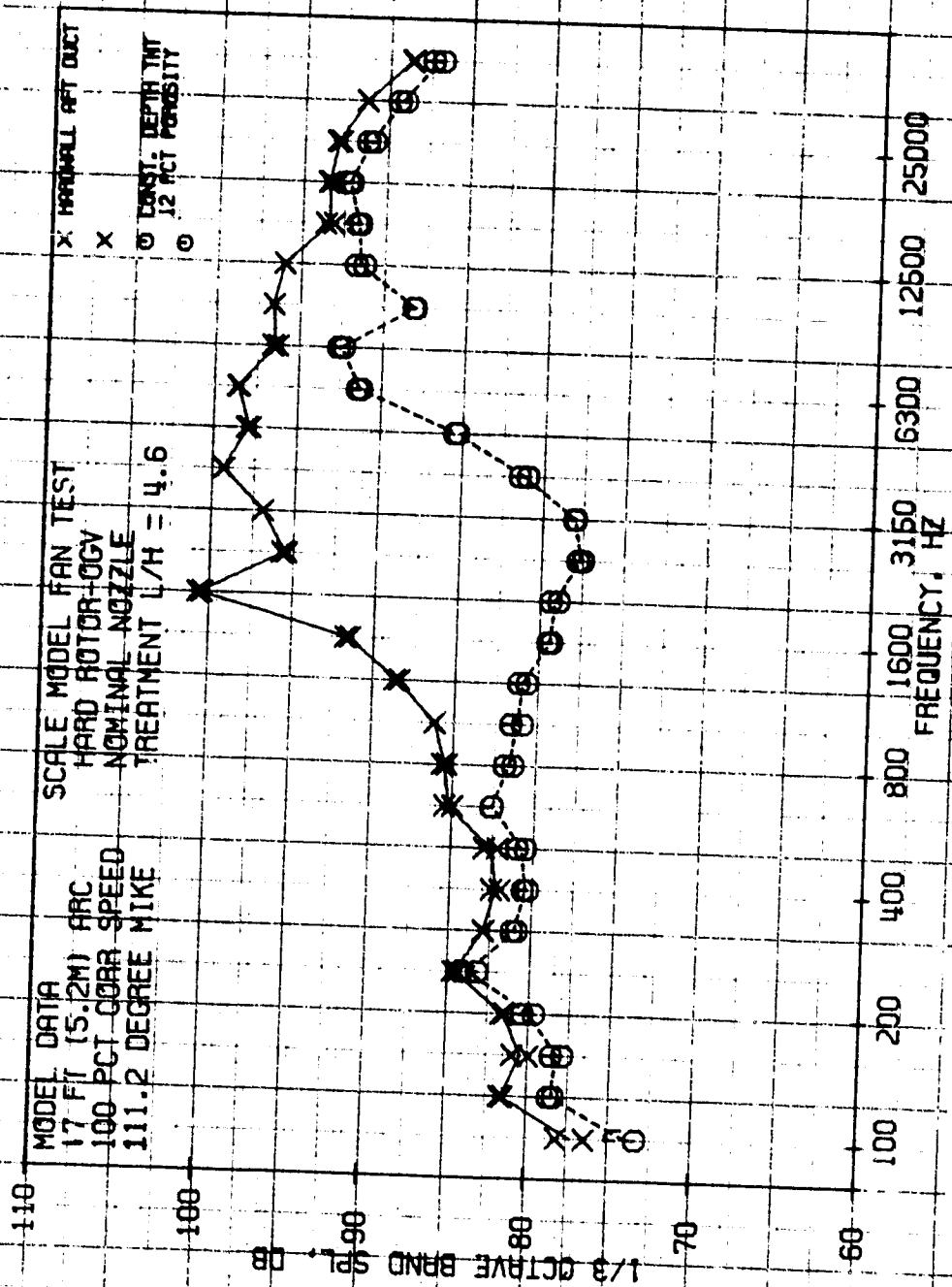


FIGURE 265



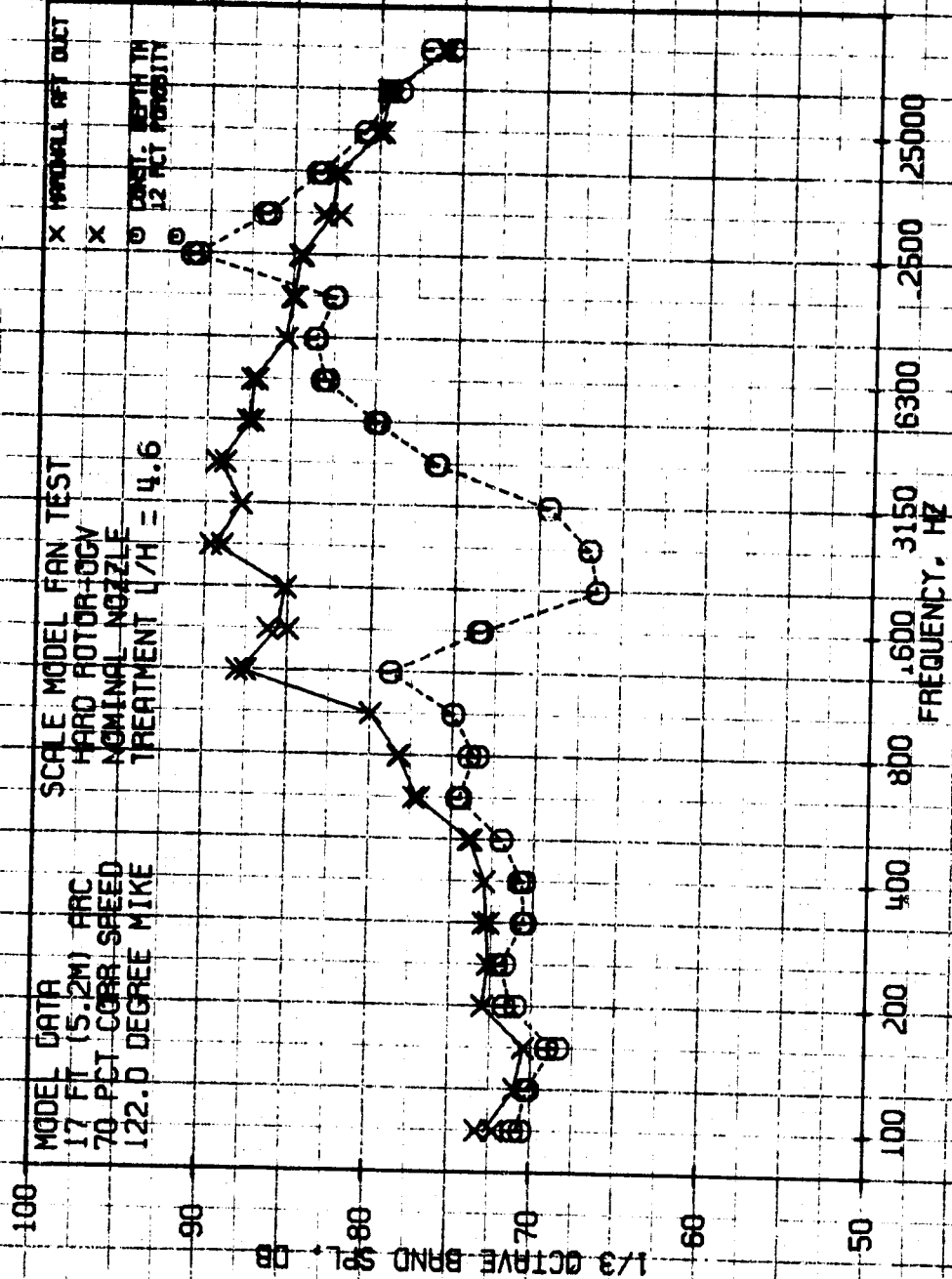


FIGURE 266

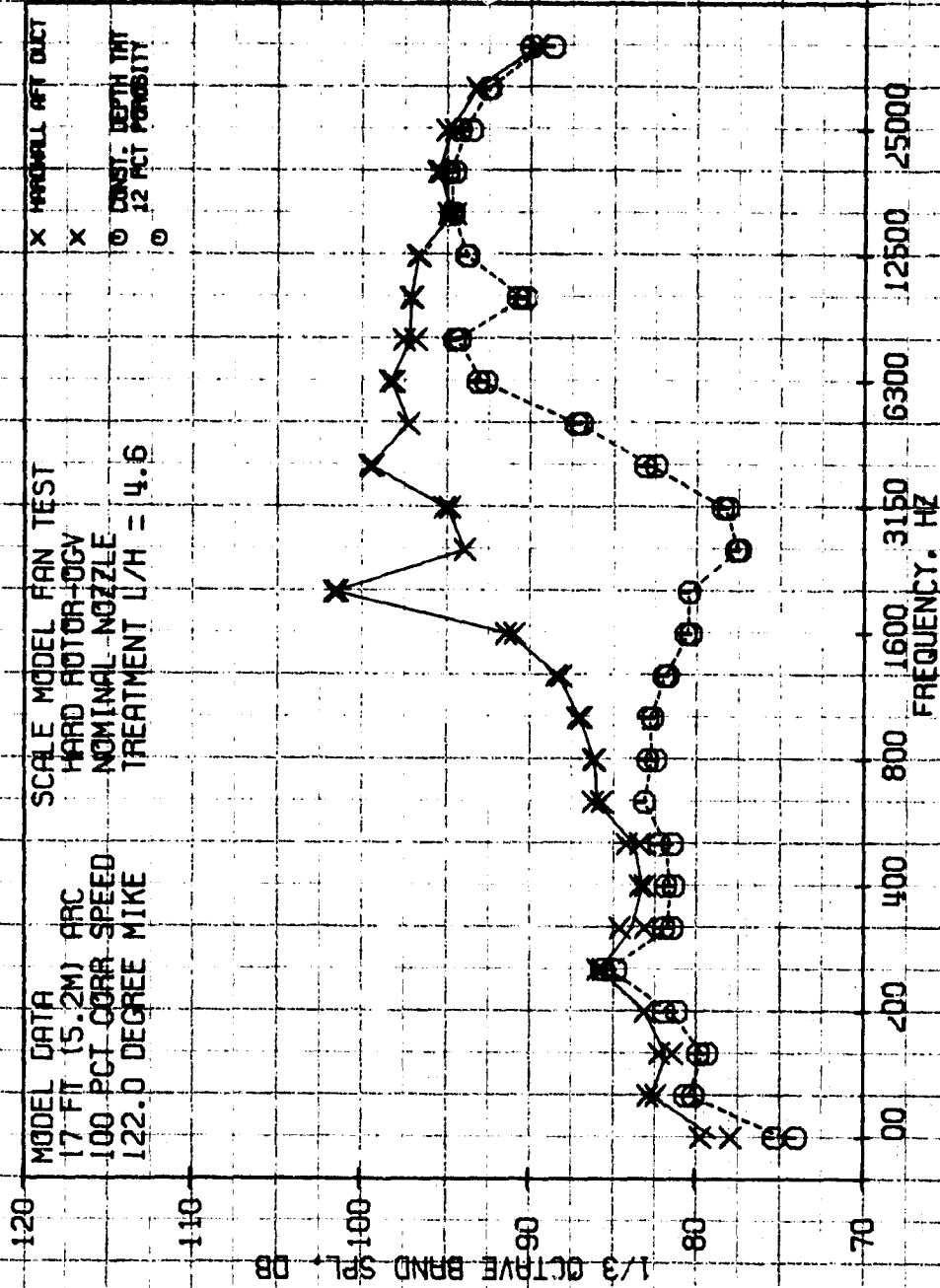
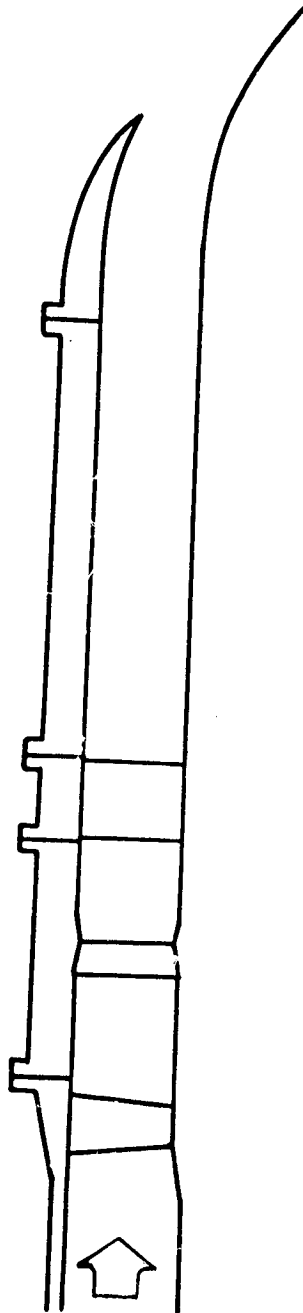


FIGURE 267

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-4, POROSITY = 12%

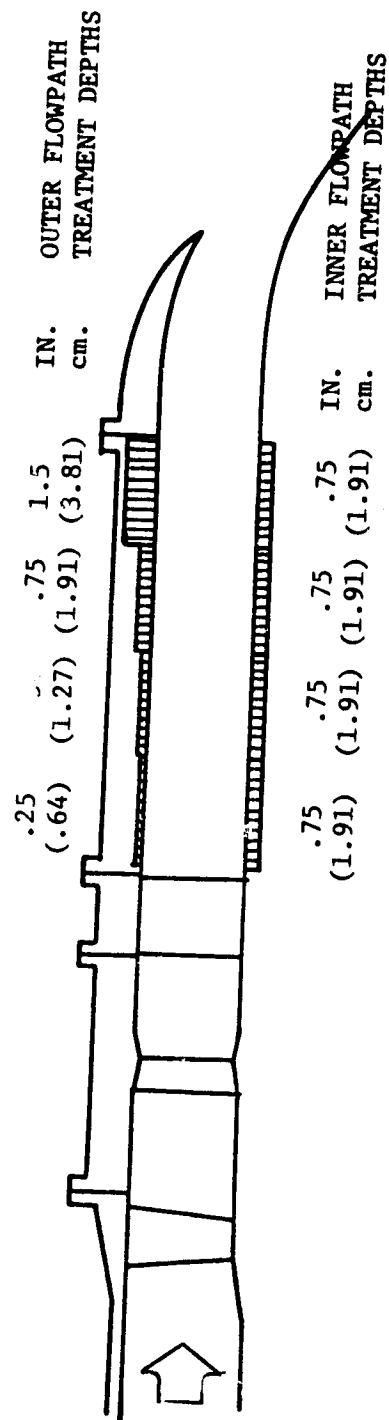


FIGURE 268. 12 PERCENT POROSITY SPLITTER SIMULATION CONFIGURATION

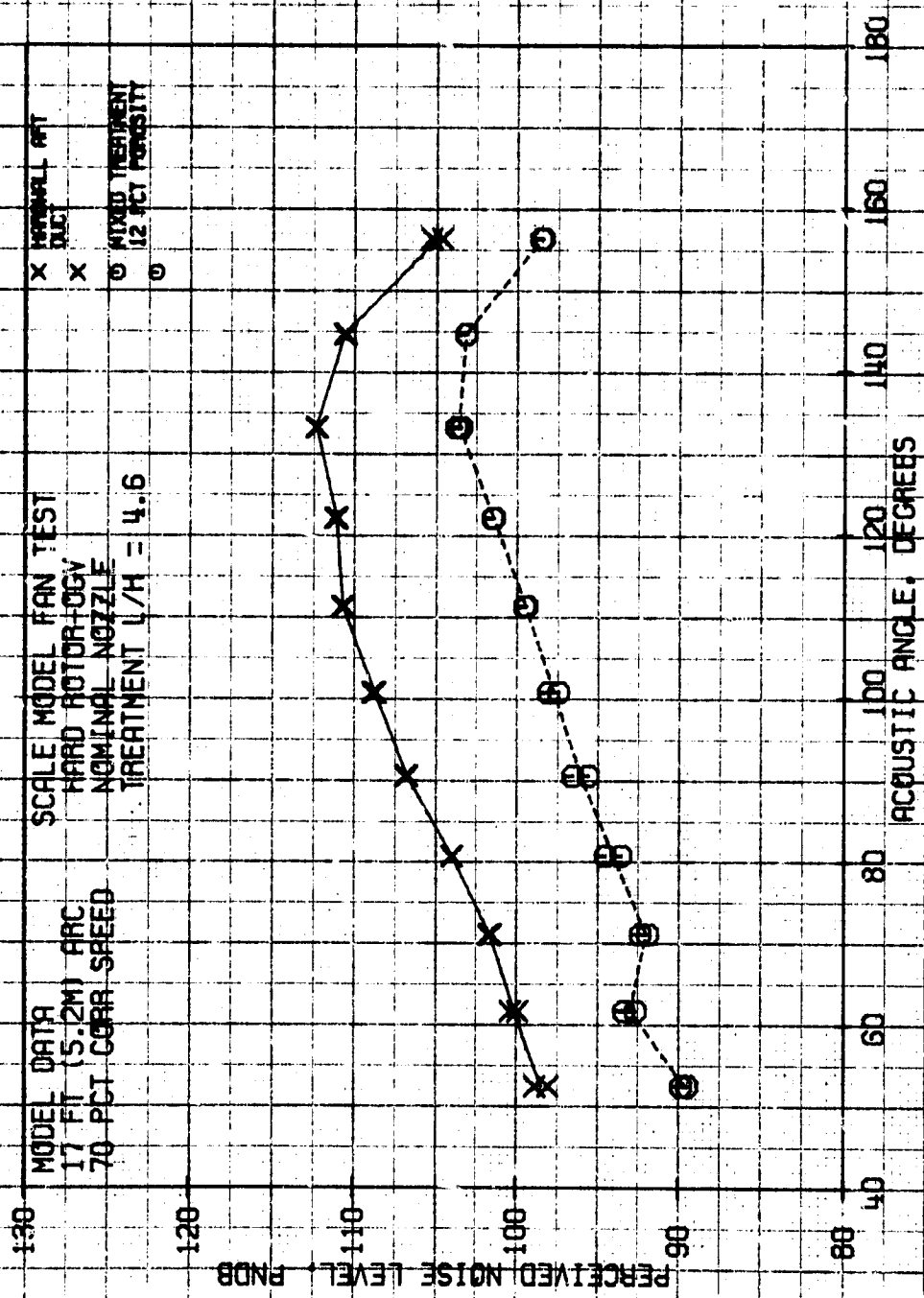


FIGURE 269

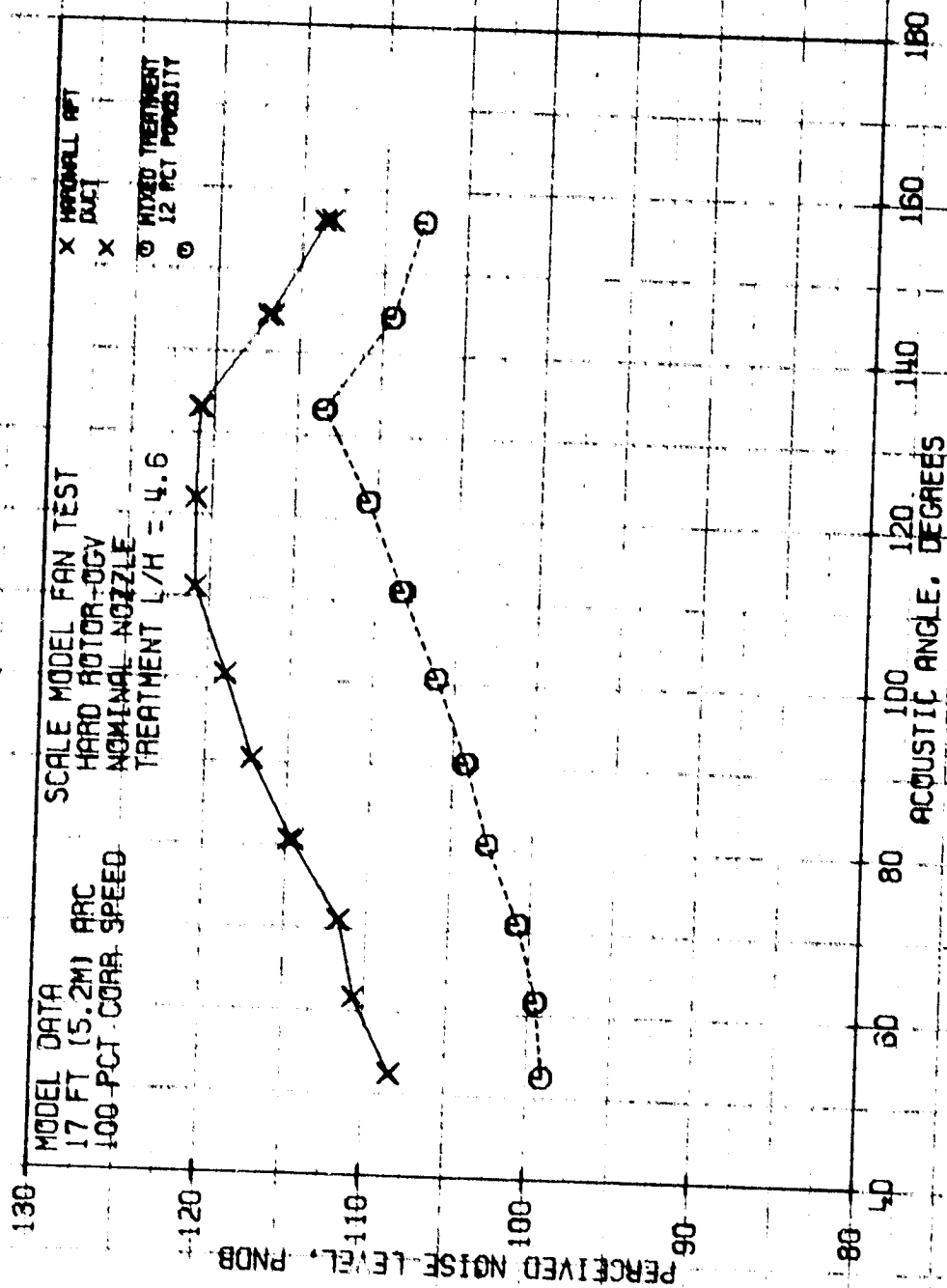


FIGURE 270

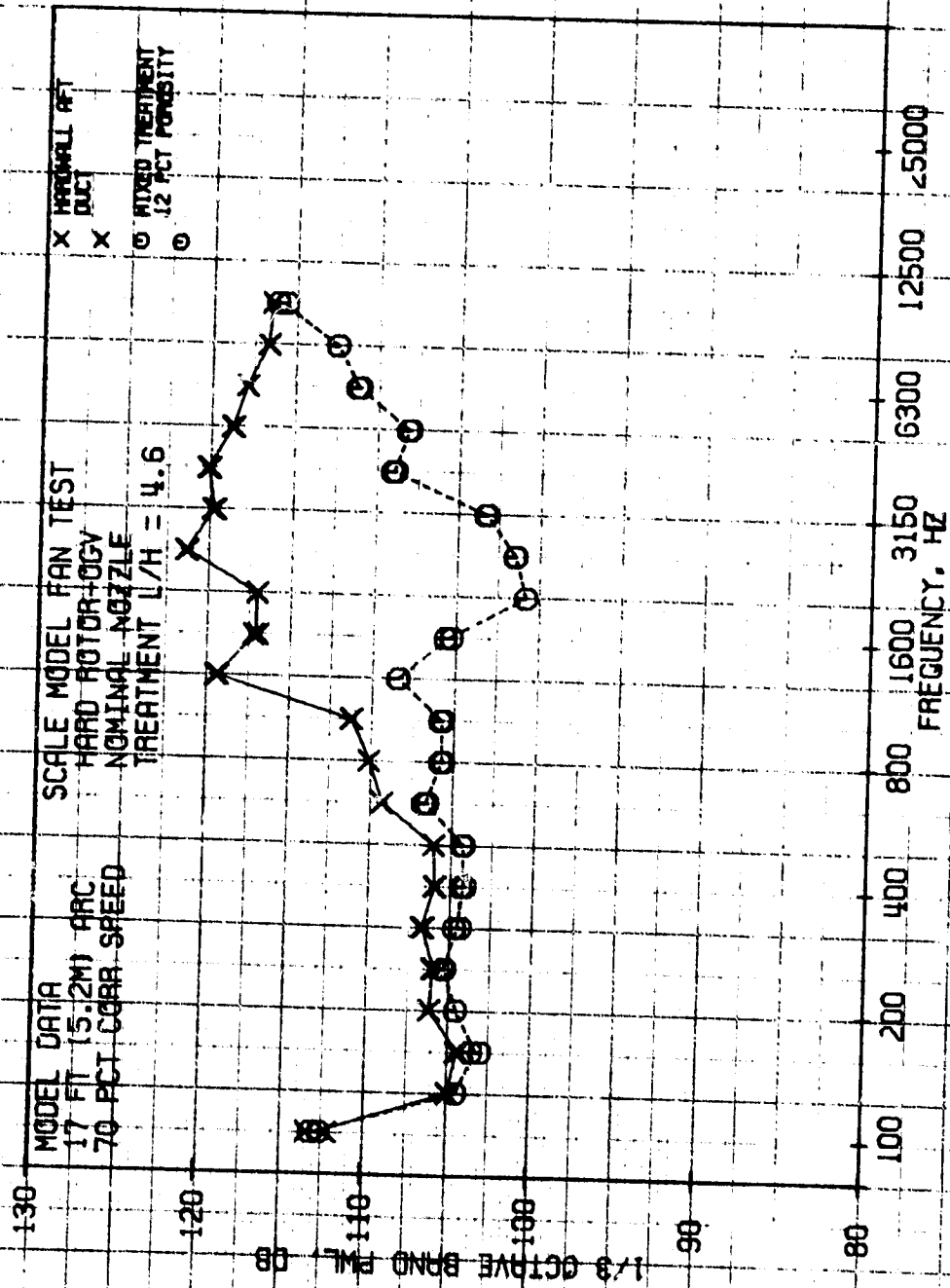


FIGURE 271

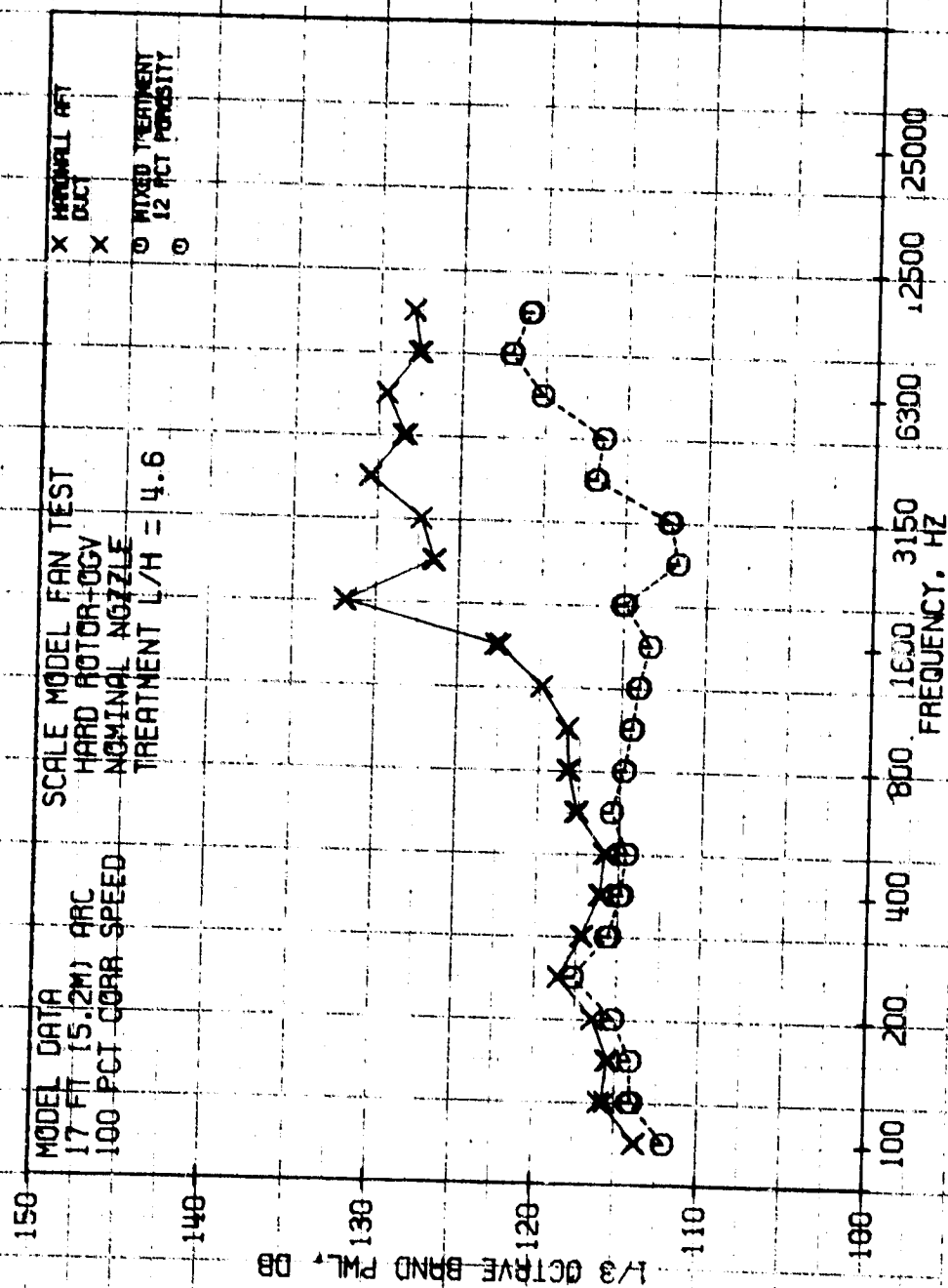


FIGURE 272

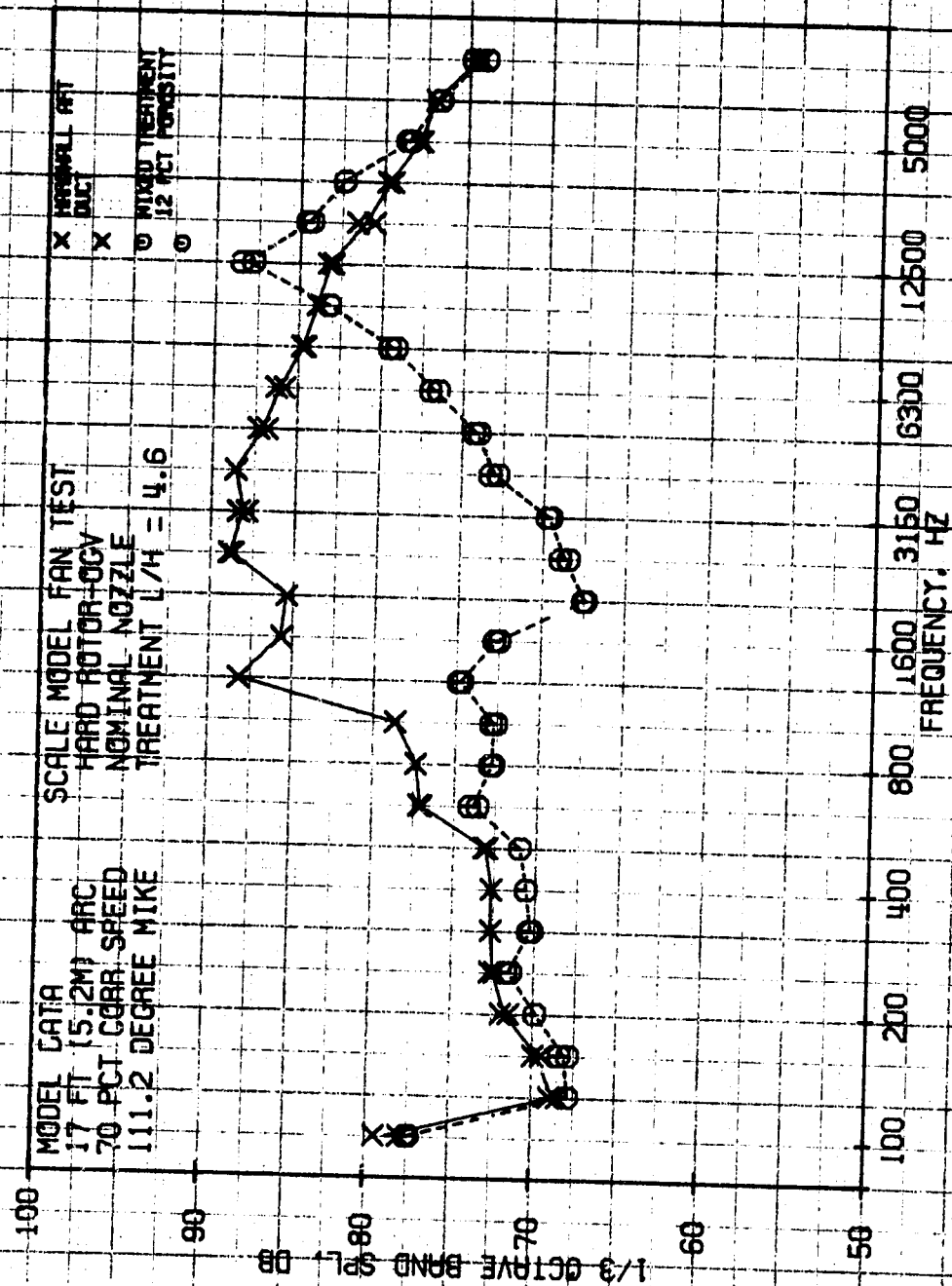


FIGURE 273



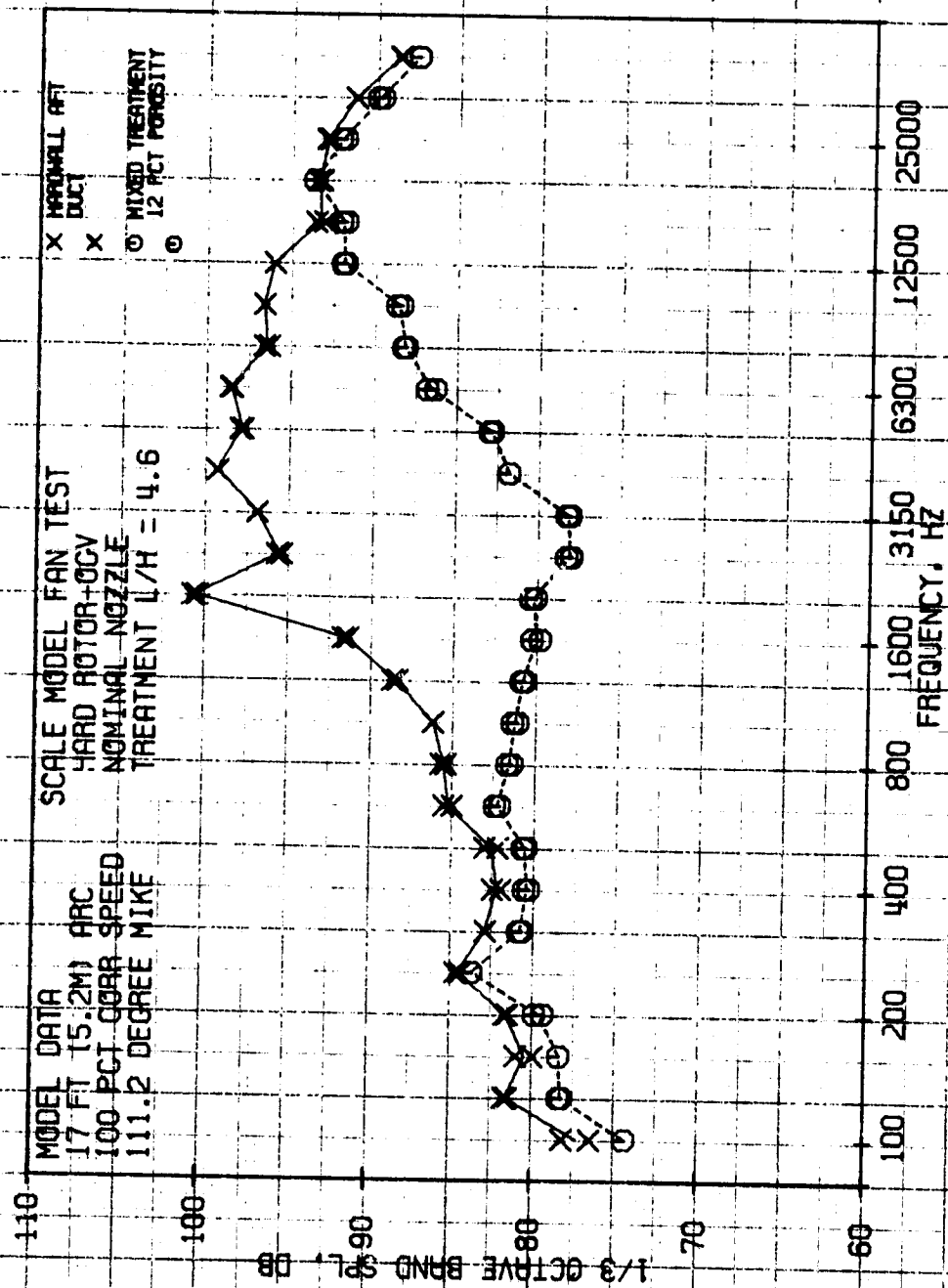


FIGURE 274

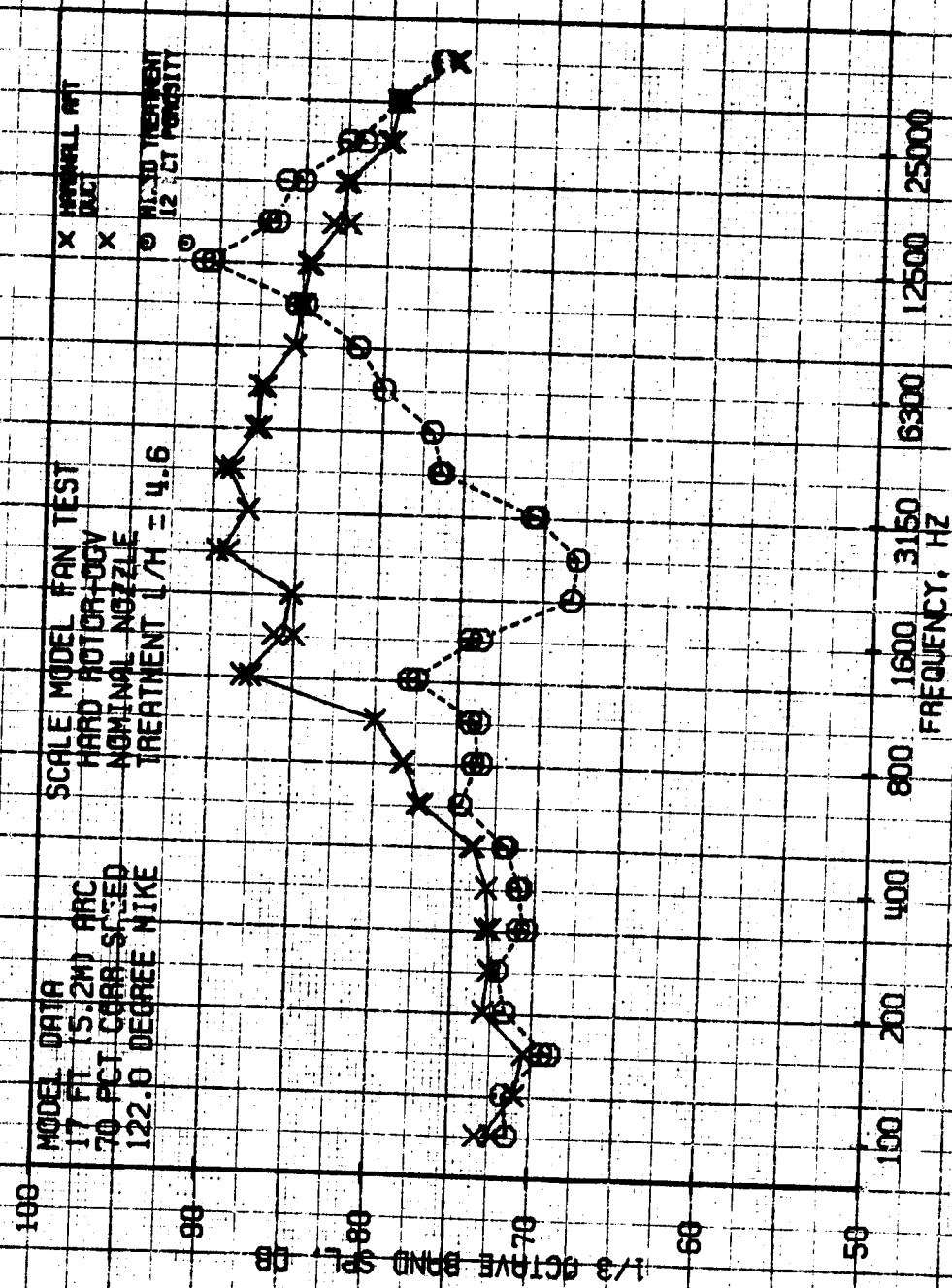


FIGURE 275

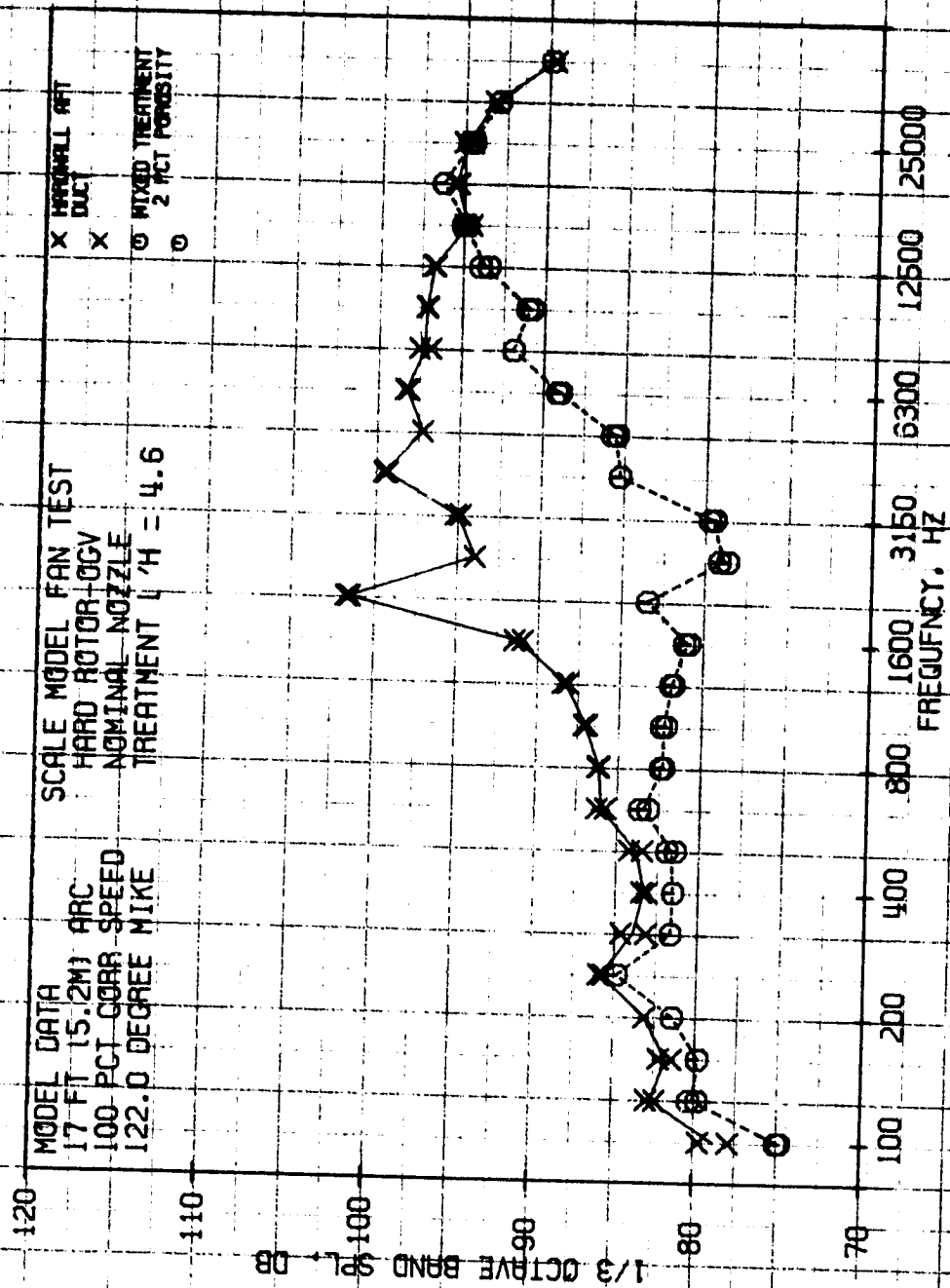
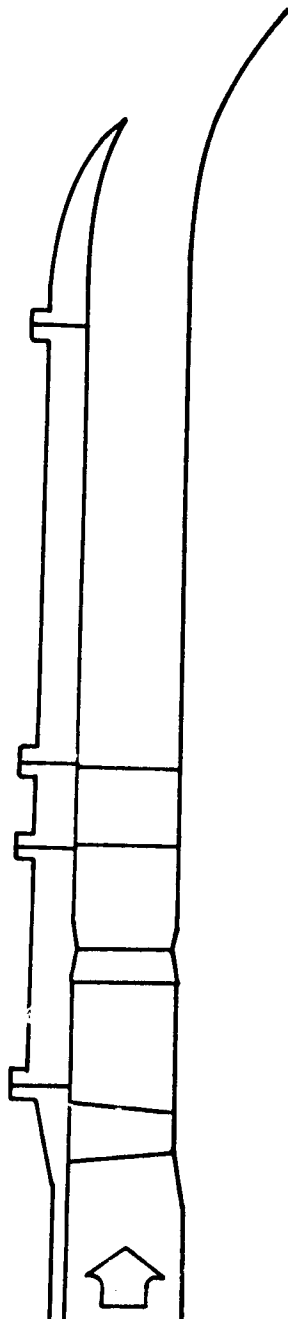


FIGURE 276

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-7, POROSITY = 12-27-12-27%

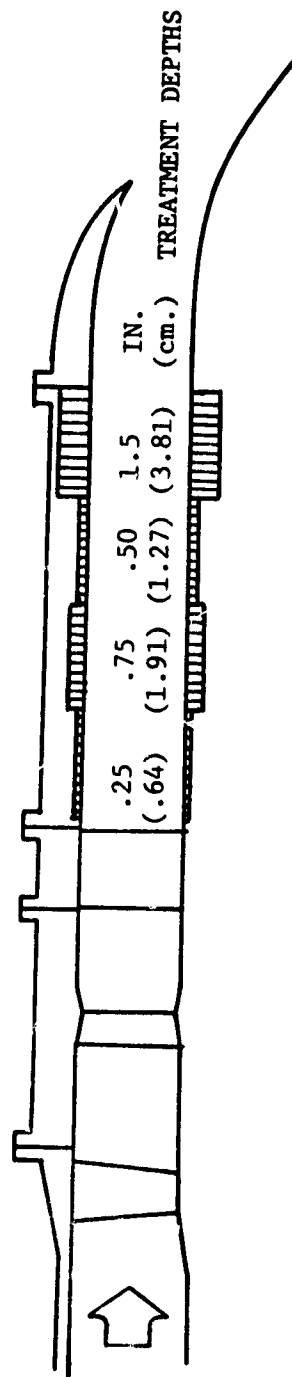


FIGURE 277. REFLECTED WAVE, POROSITY = 12-27-12-27 CONFIGURATION

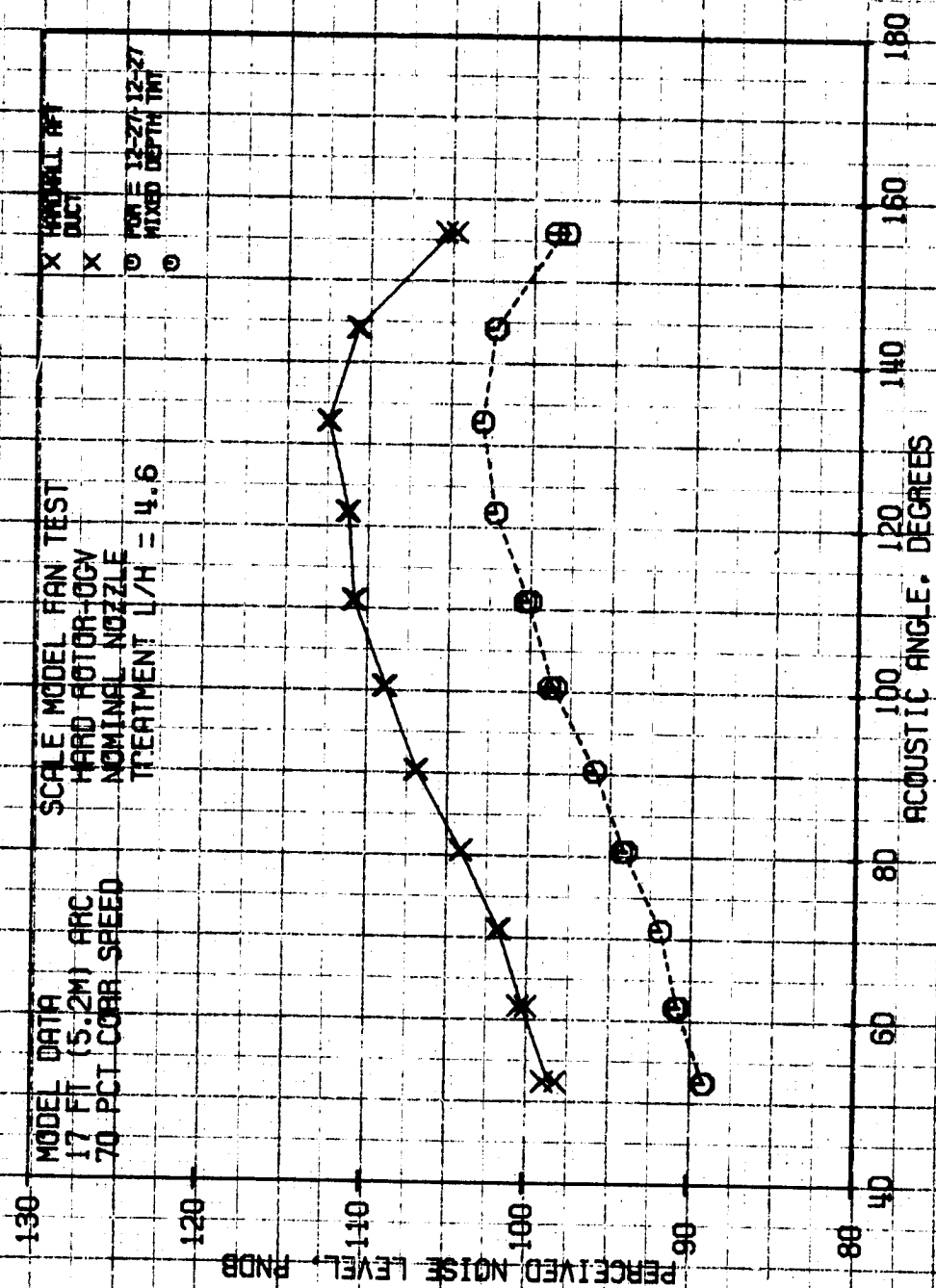


FIGURE 278

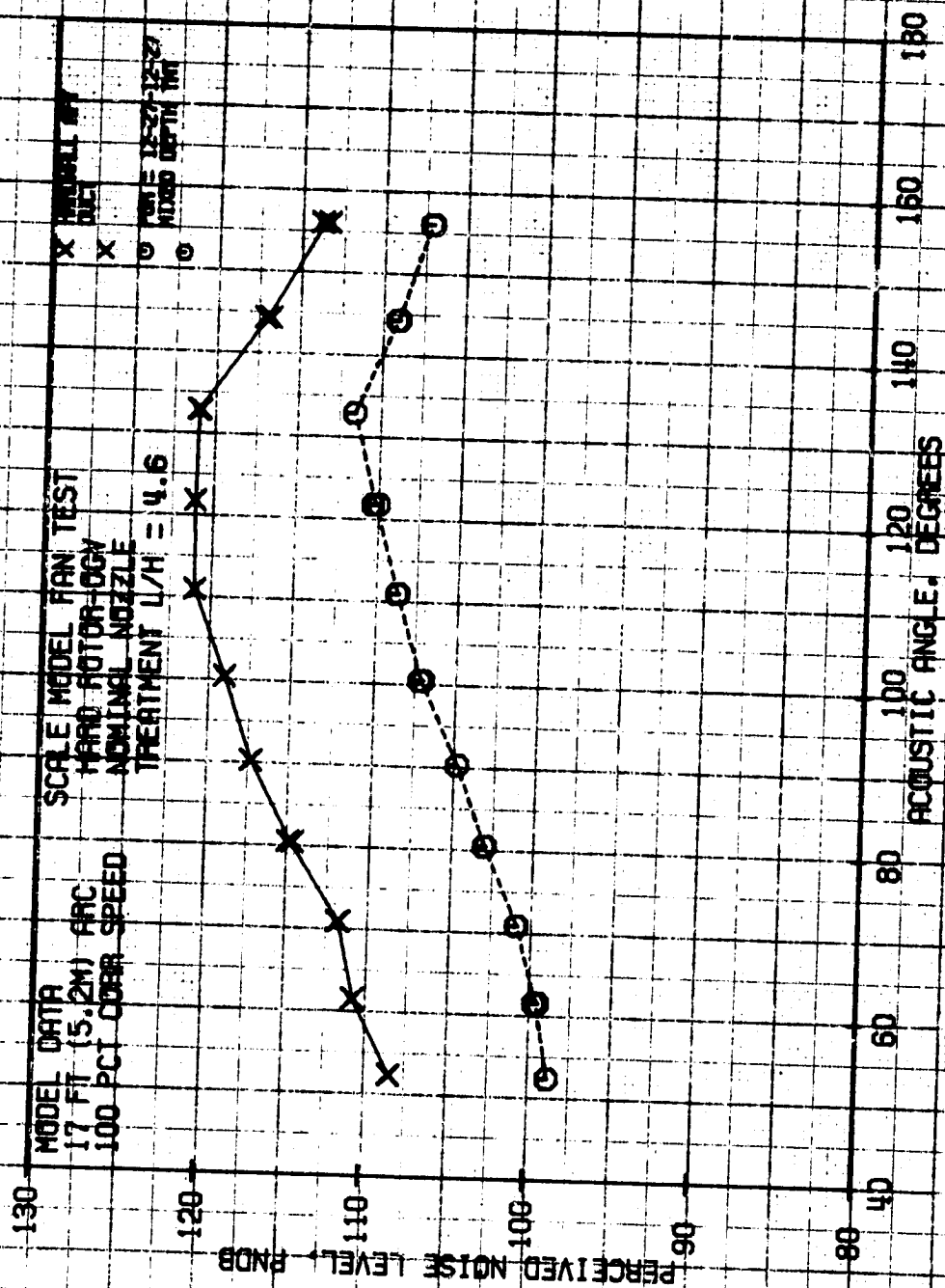


FIGURE 279

4

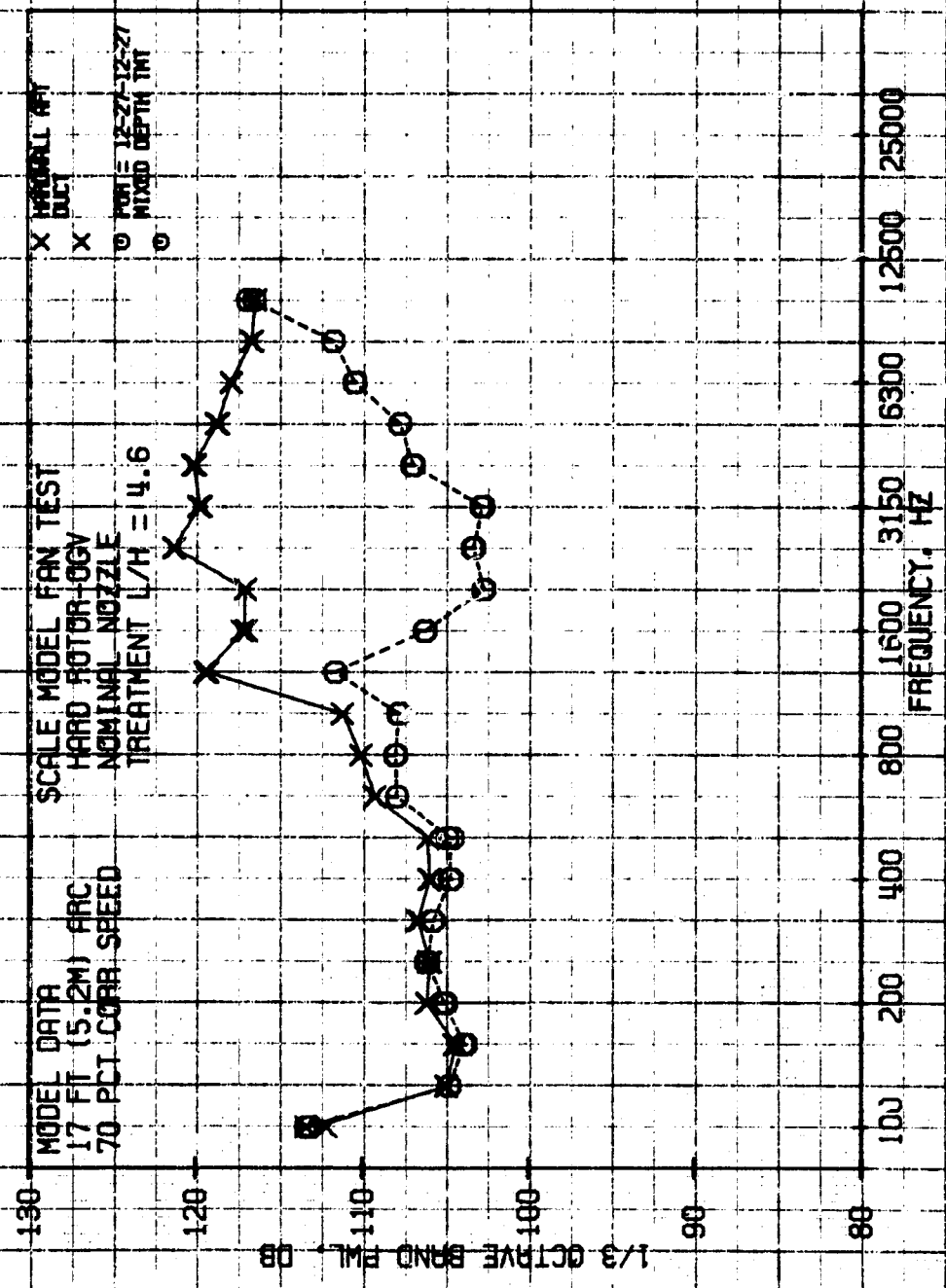


FIGURE 280

75-7

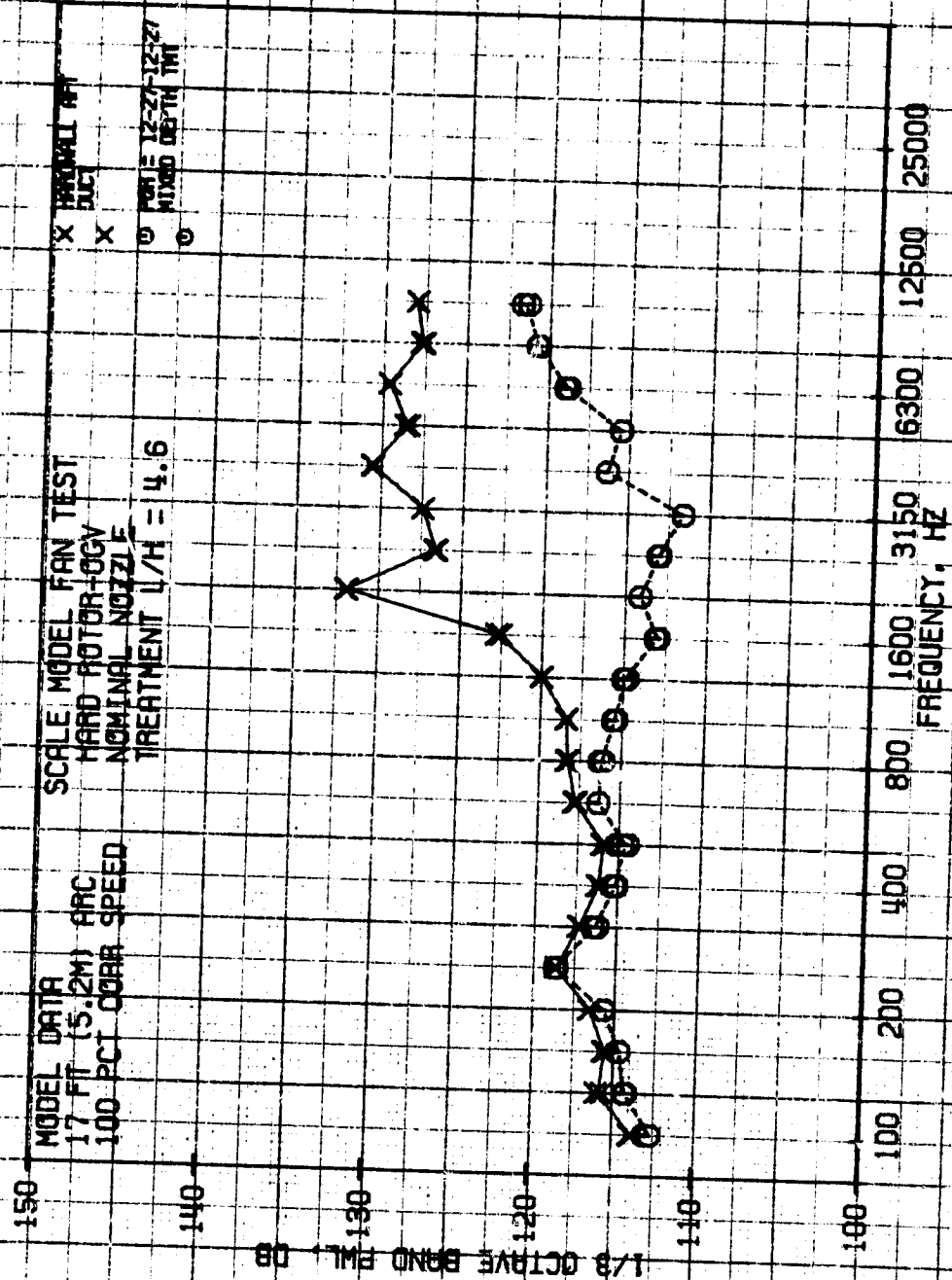


FIGURE 281



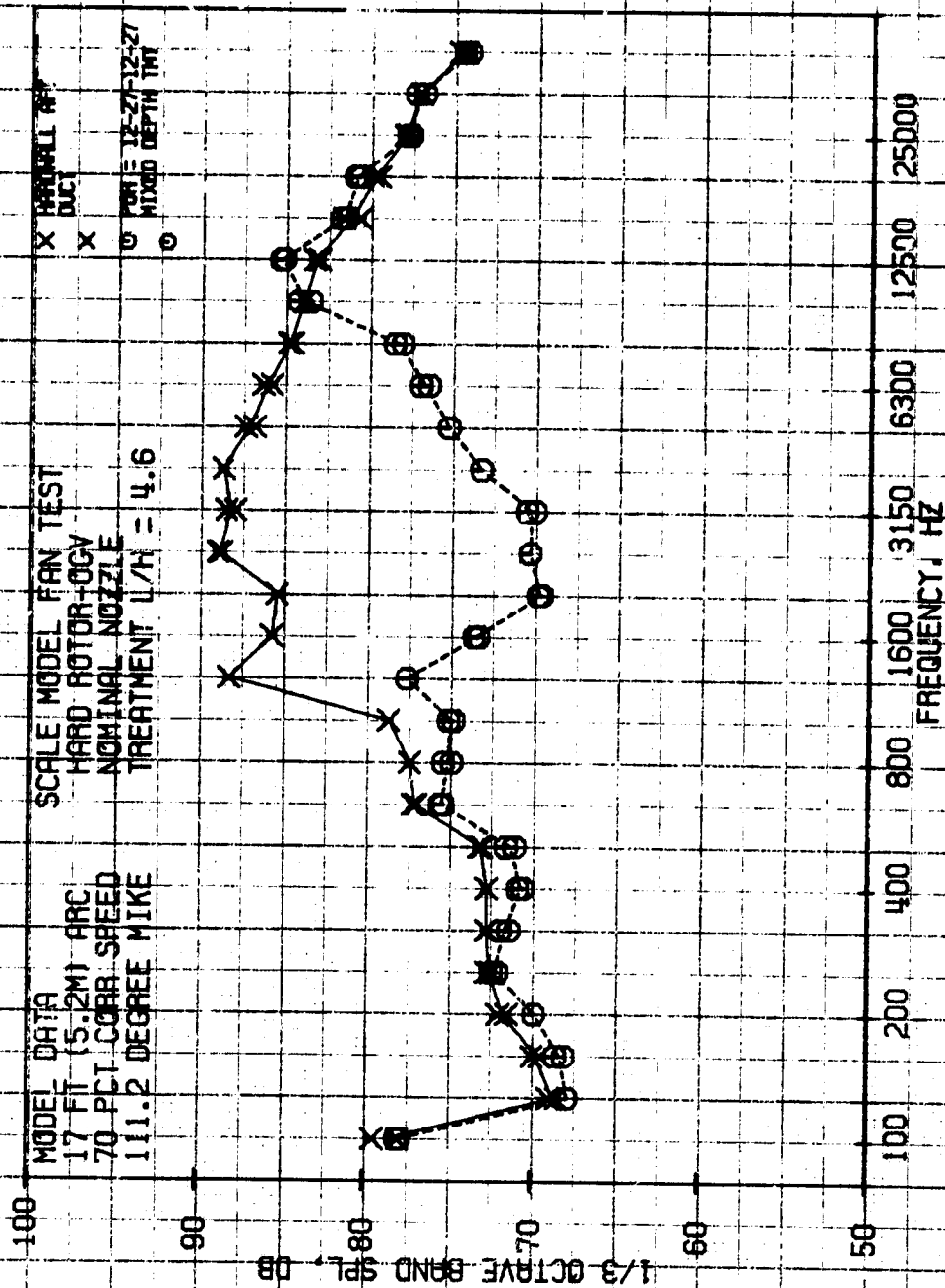


FIGURE 282

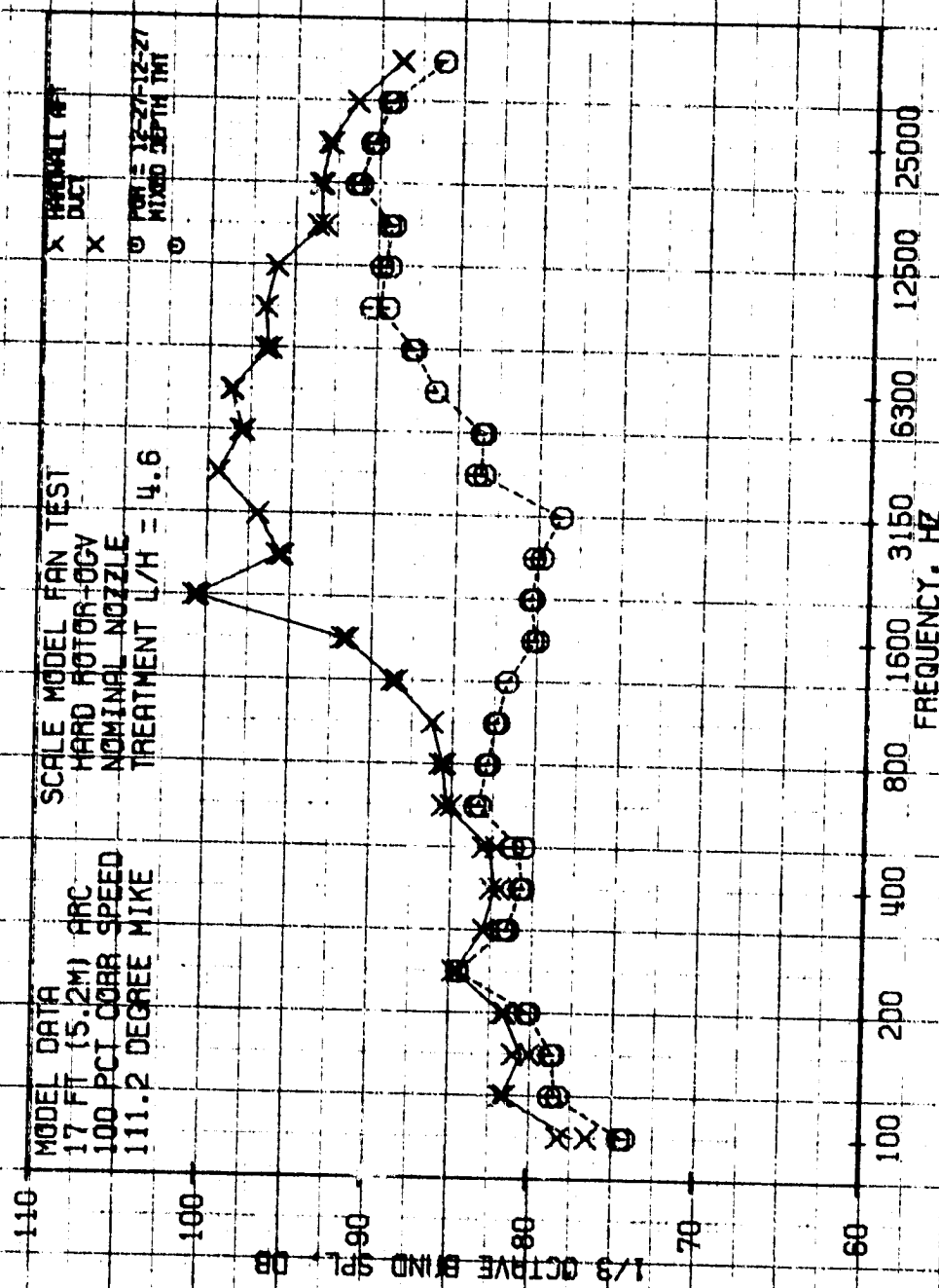


FIGURE 283

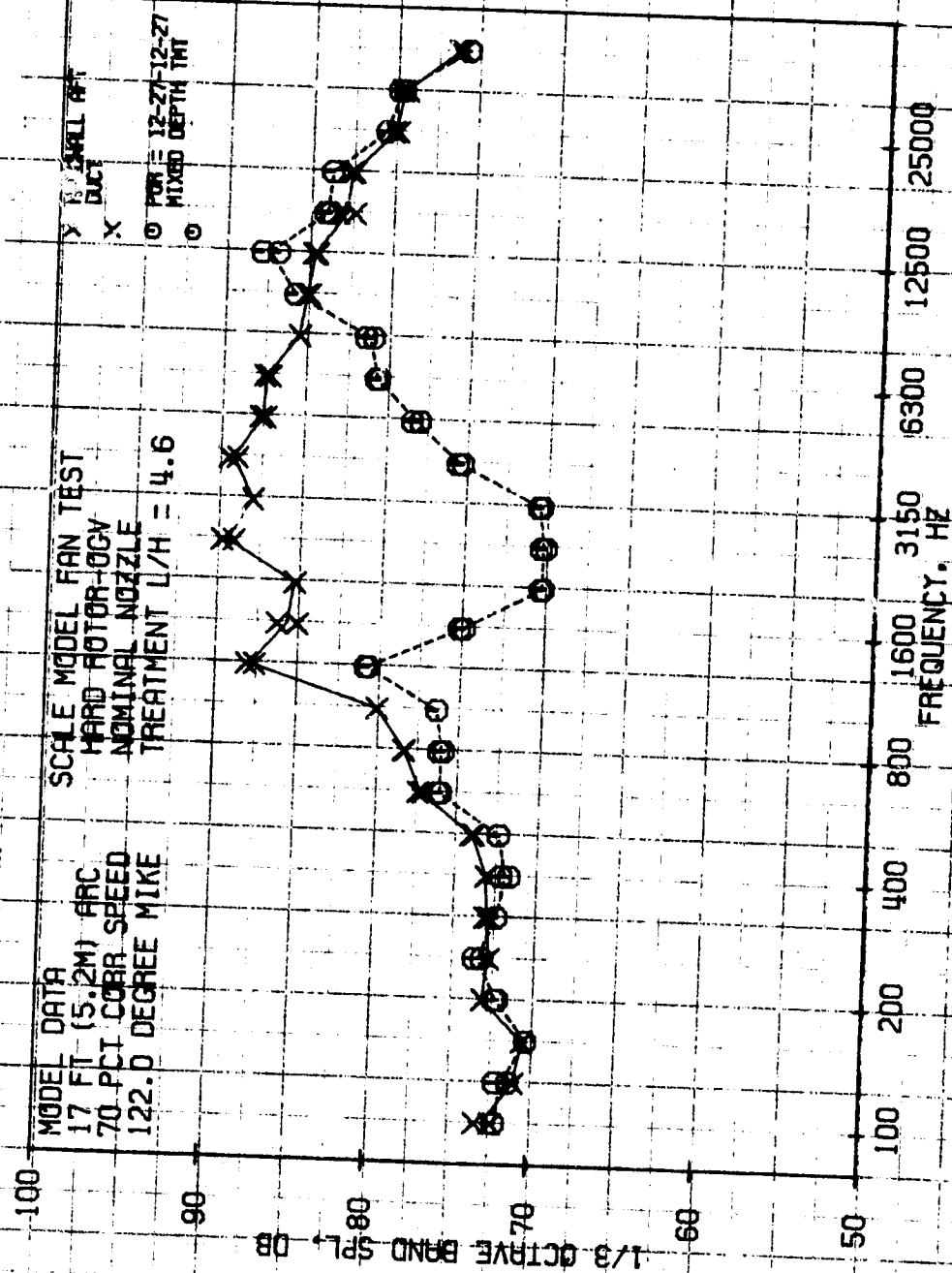


FIGURE 284

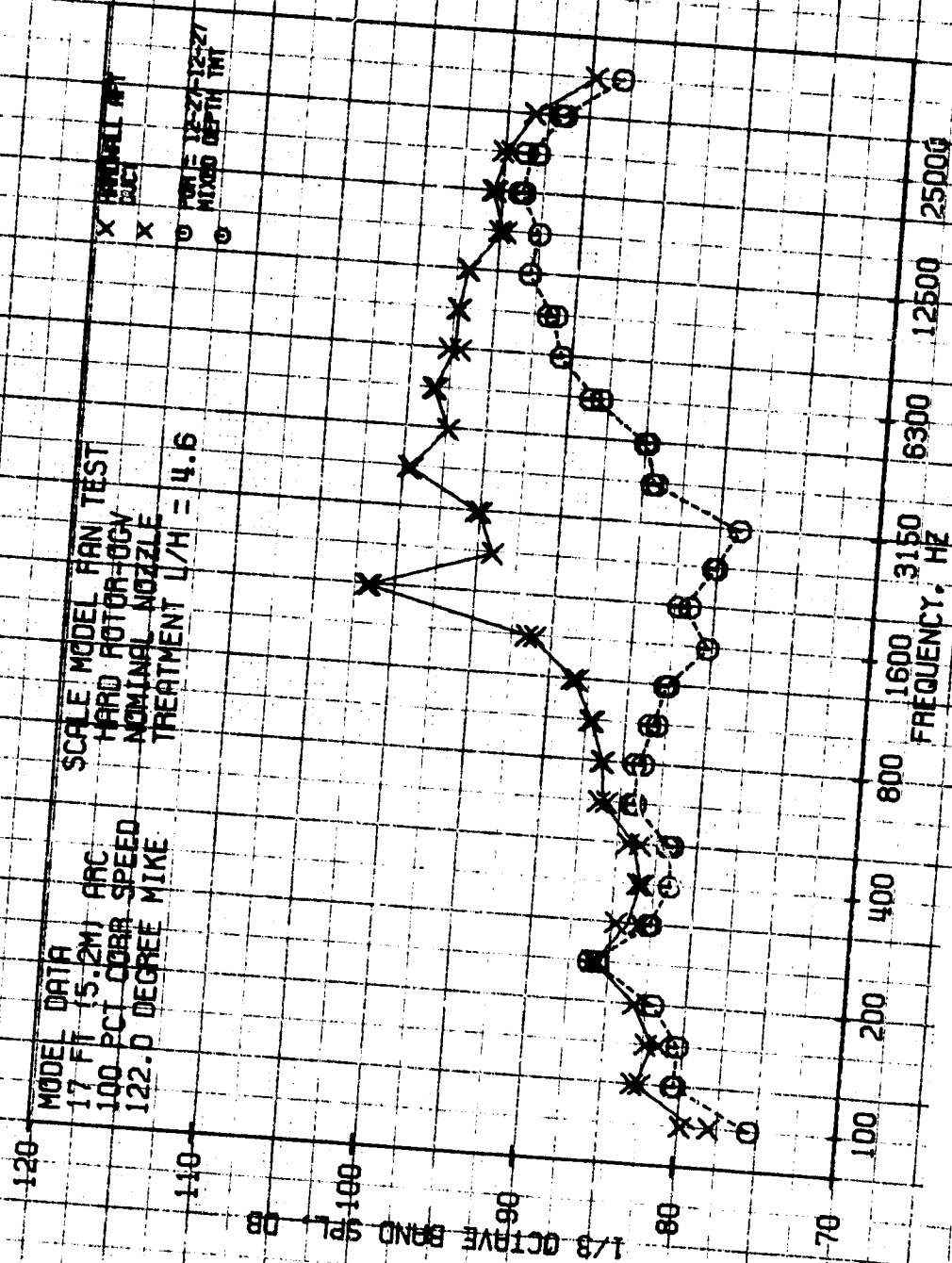
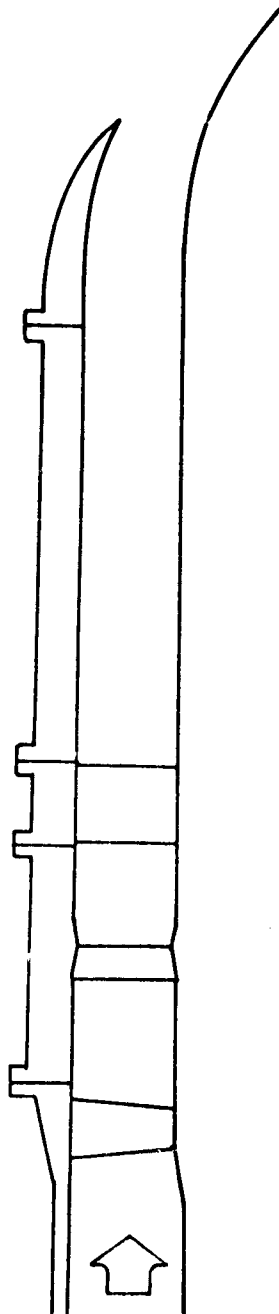


FIGURE 285

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-8, POROSITY = 12-12-12-27%

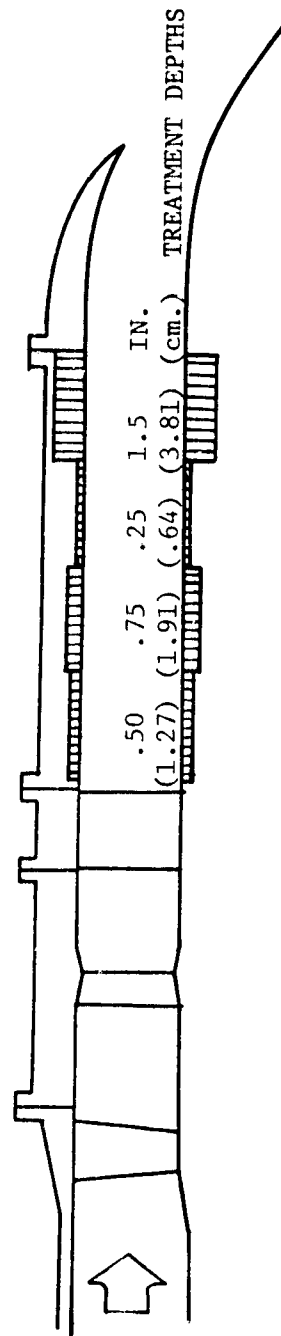


FIGURE 286. REFLECTED WAVE, POROSITY = 12-12-12-27 CONFIGURATION

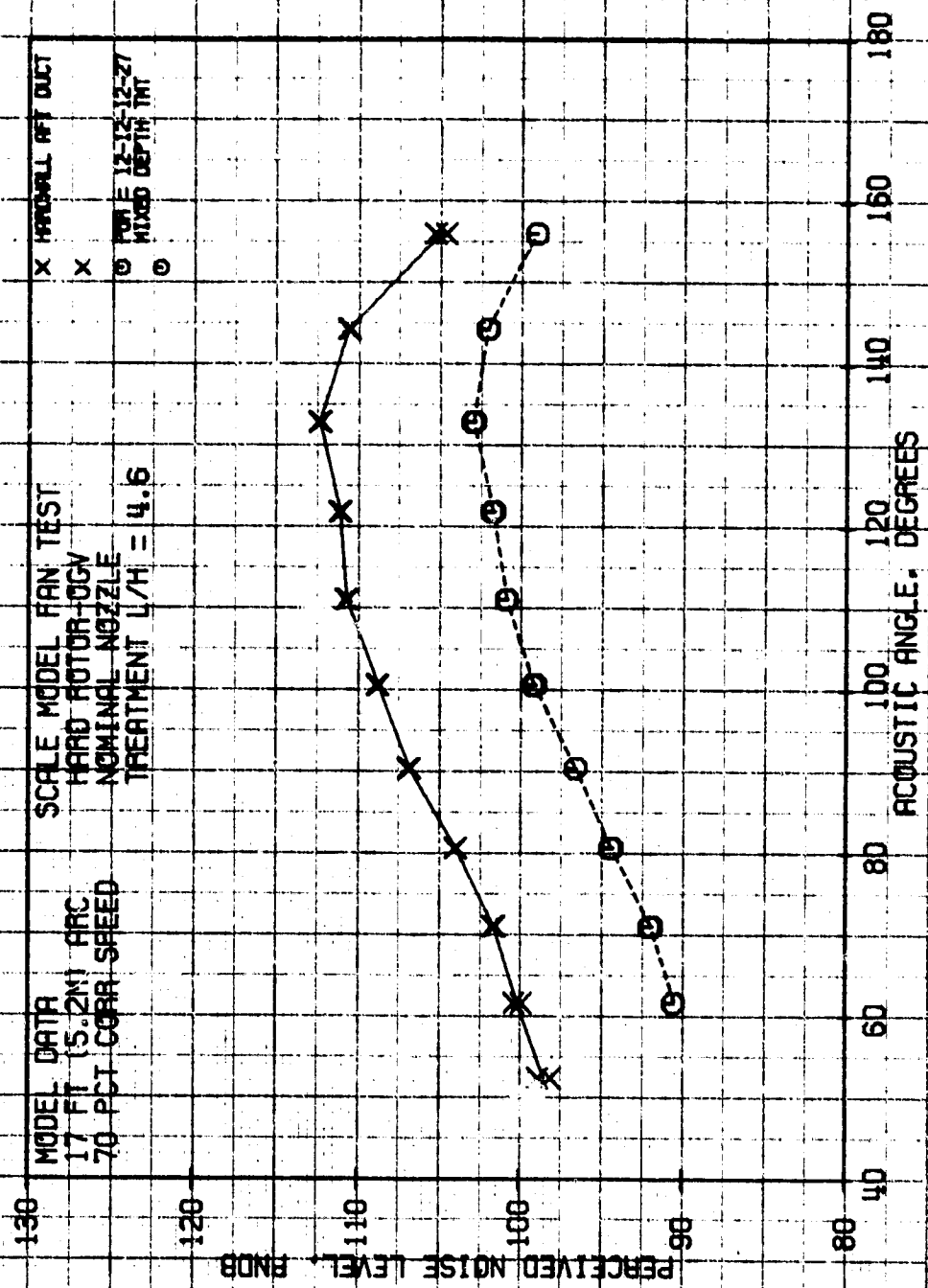


FIGURE 287

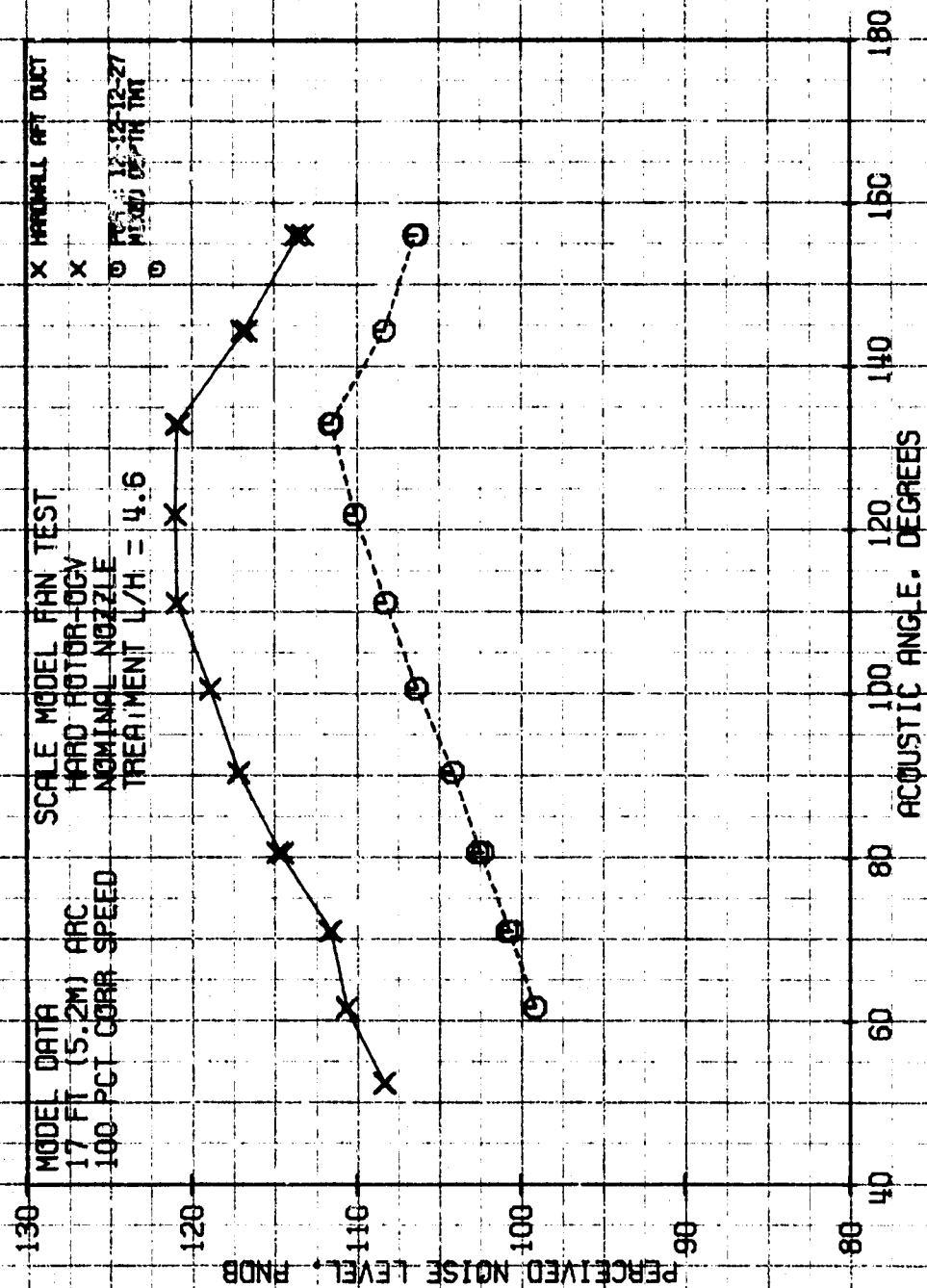


FIGURE 288

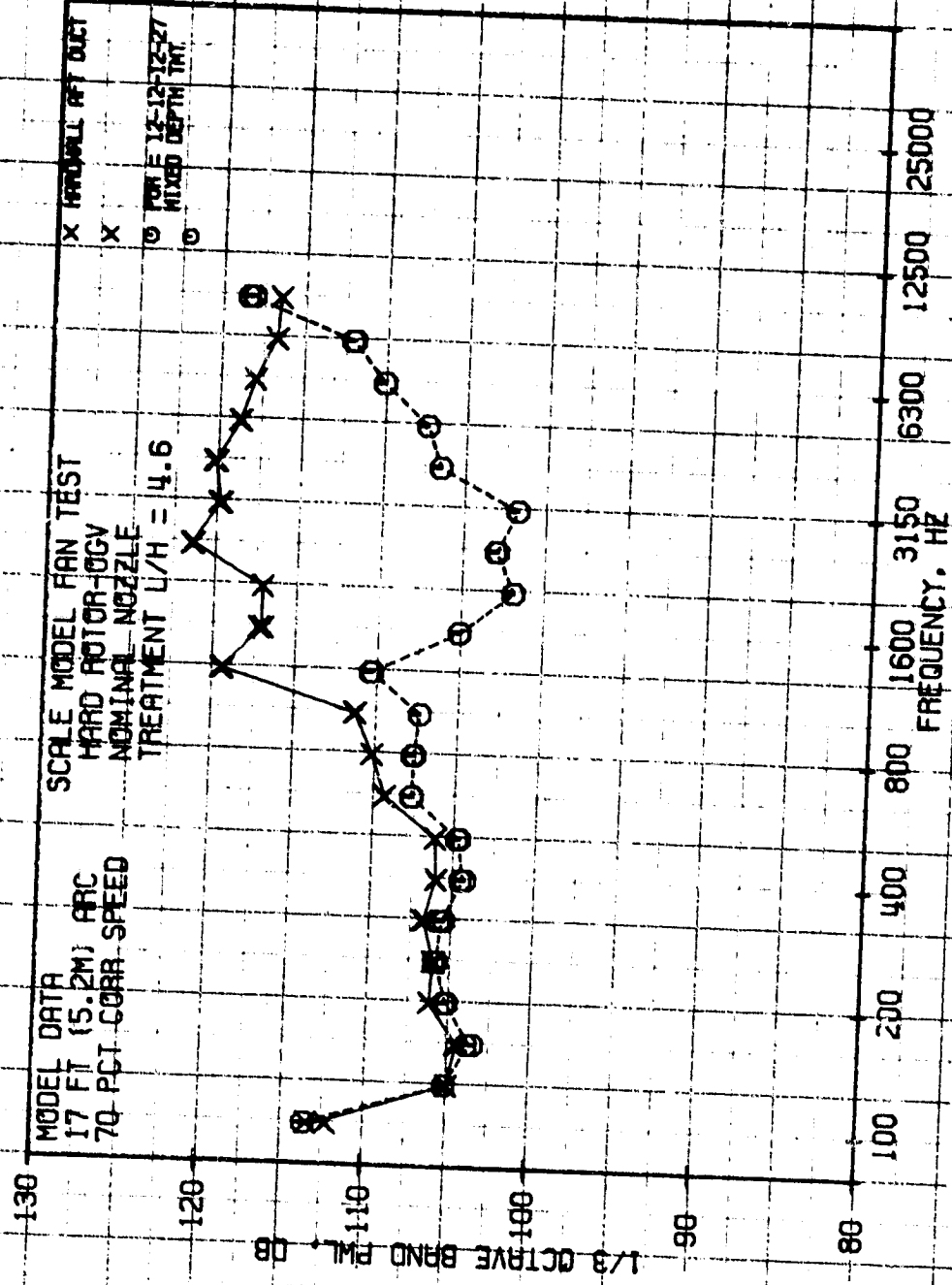


FIGURE 289



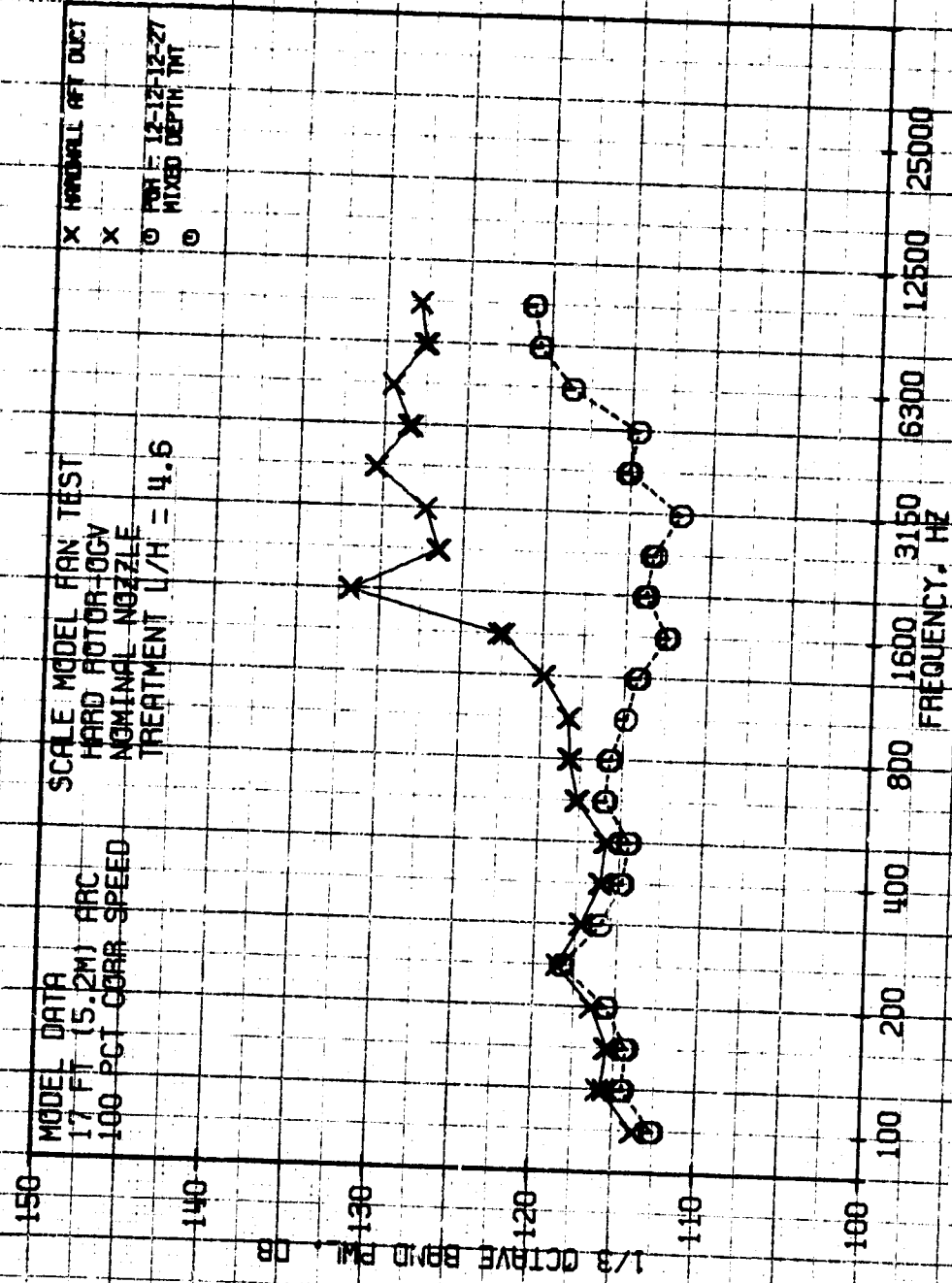


FIGURE 290



ORIGINAL PAGE IS  
OF POOR QUALITY

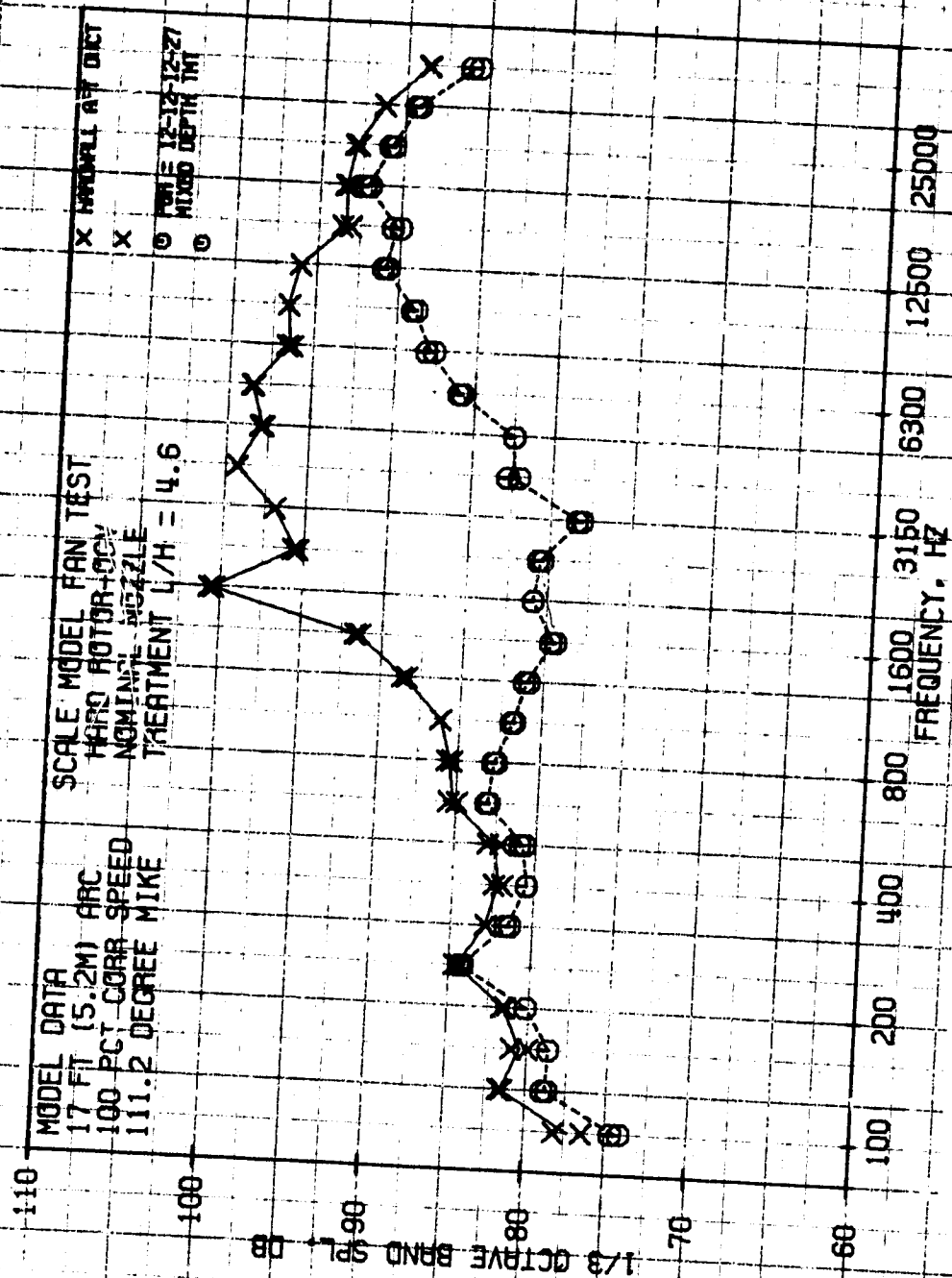


FIGURE 292

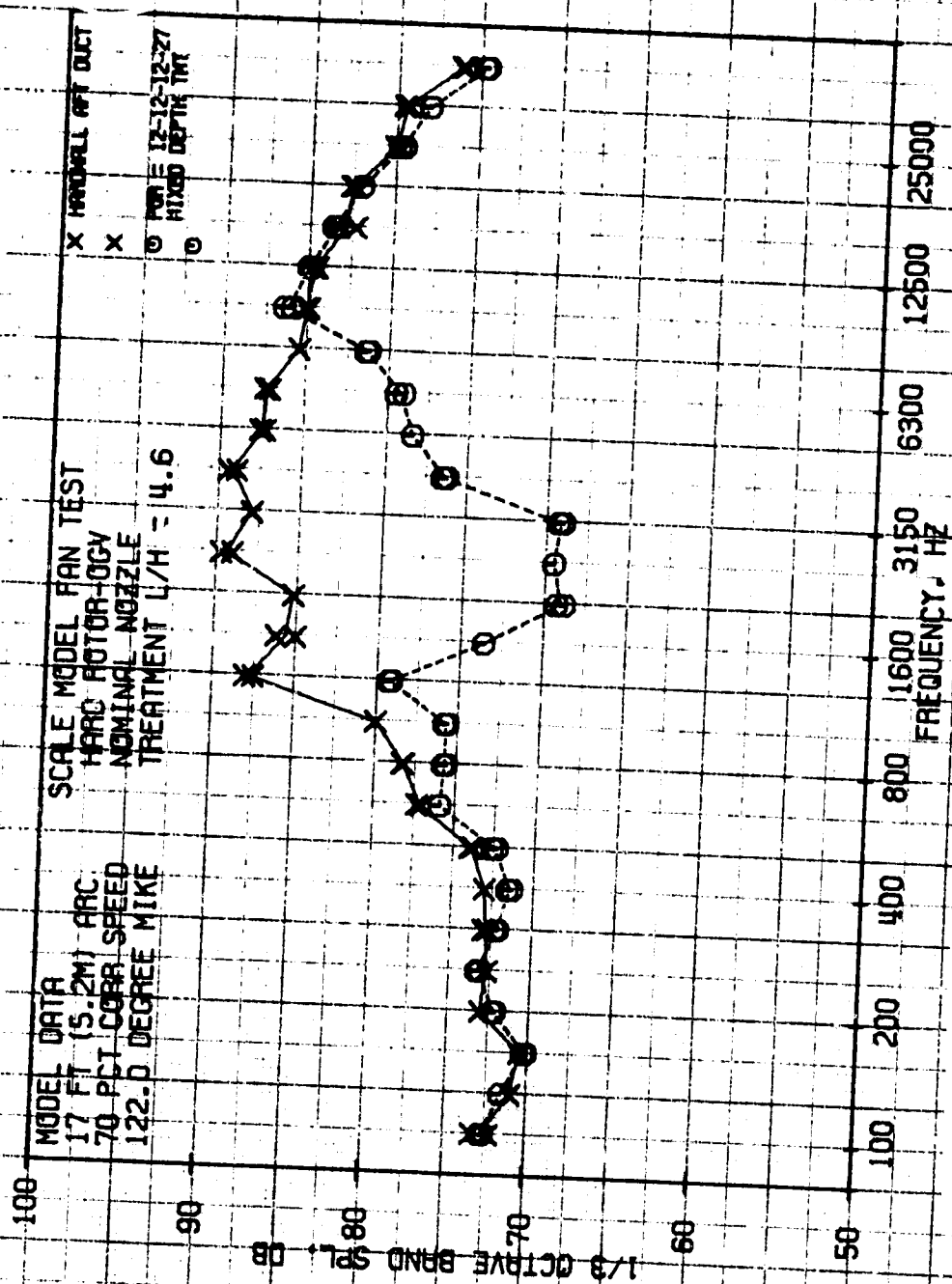


FIGURE 293

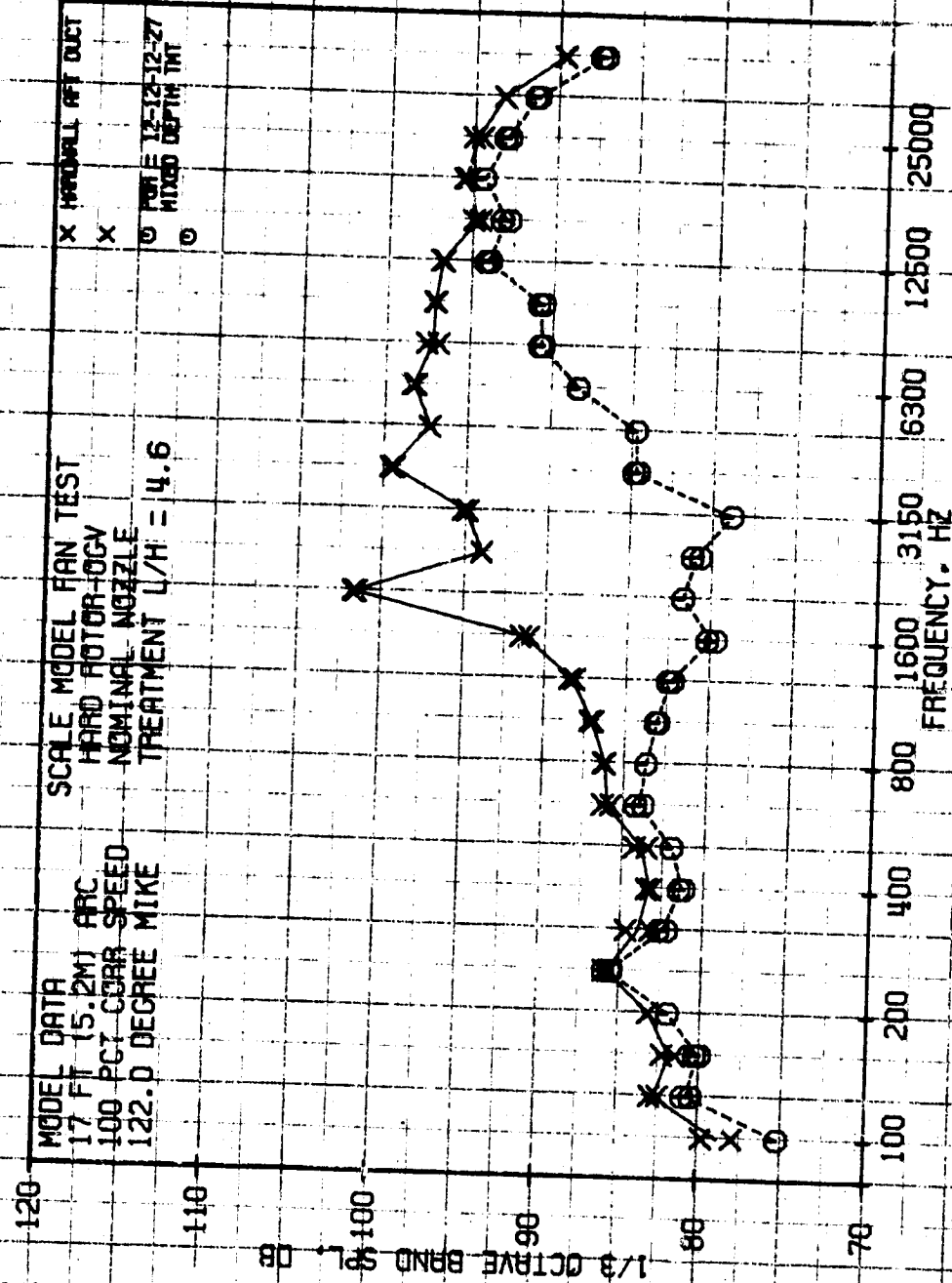
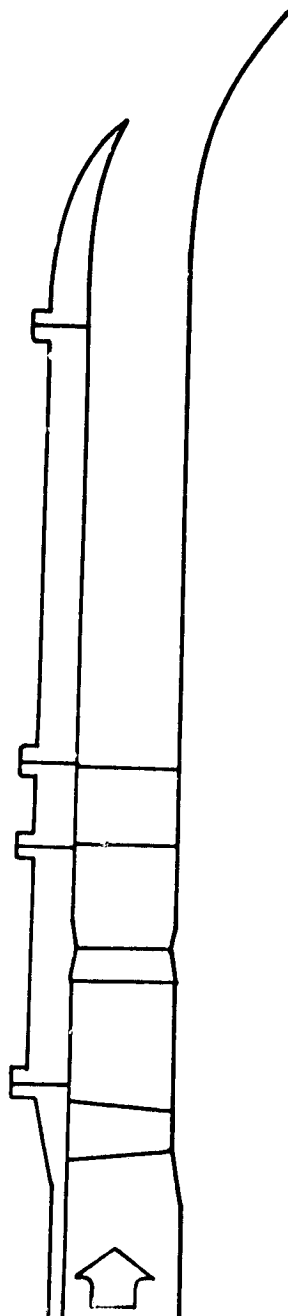


FIGURE 294

CONFIGURATION 18, HARDWALL



CONFIGURATION 75-9, POROSITY = 12%,  $L/H = 3.68$

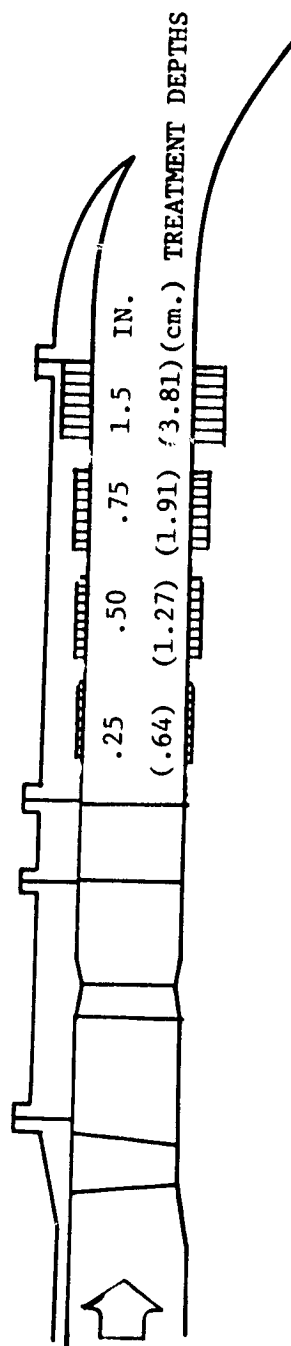


FIGURE 295. VARIABLE DEPTH,  $L/H = 3.68$  CONFIGURATION

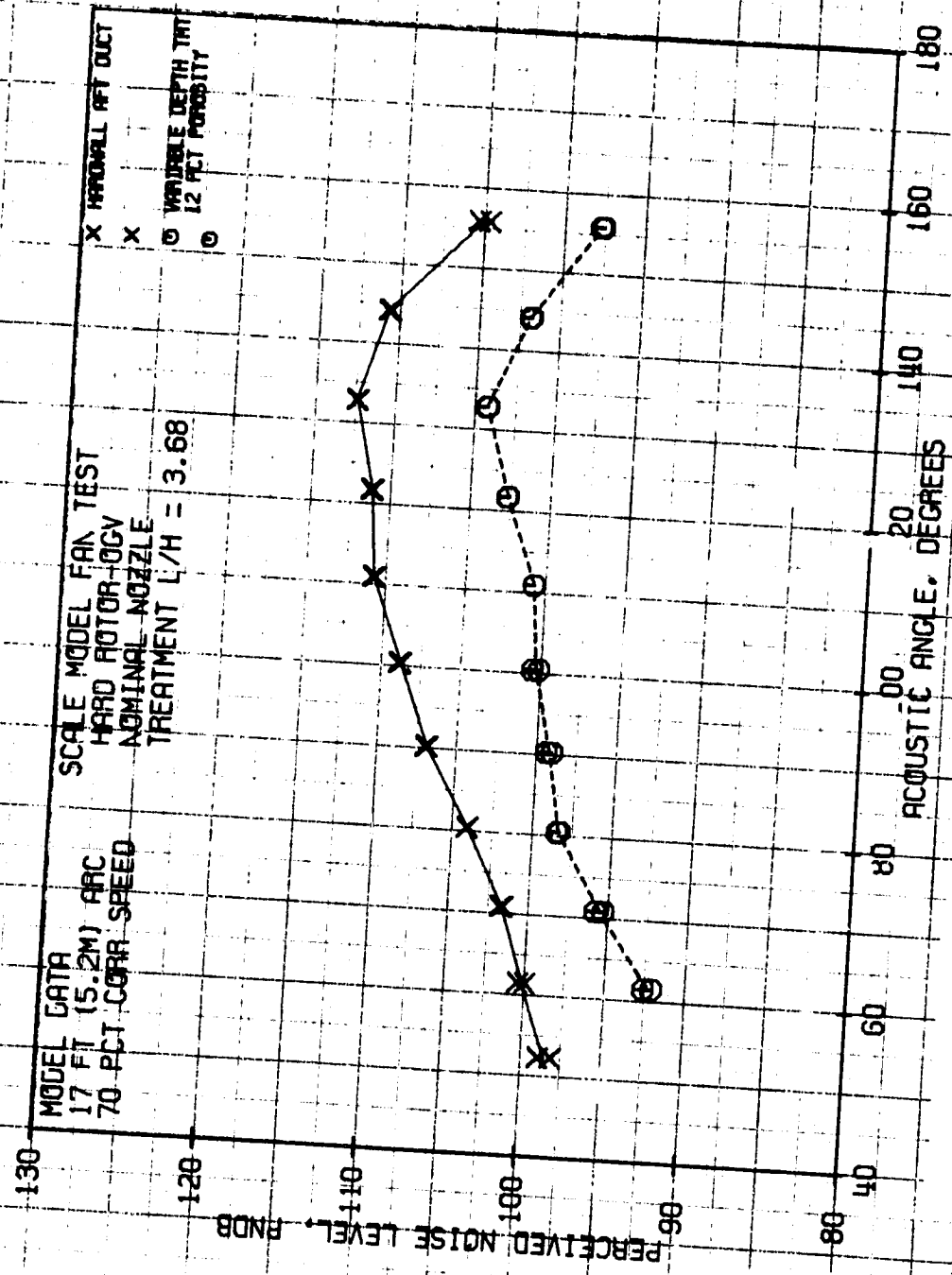


FIGURE 296

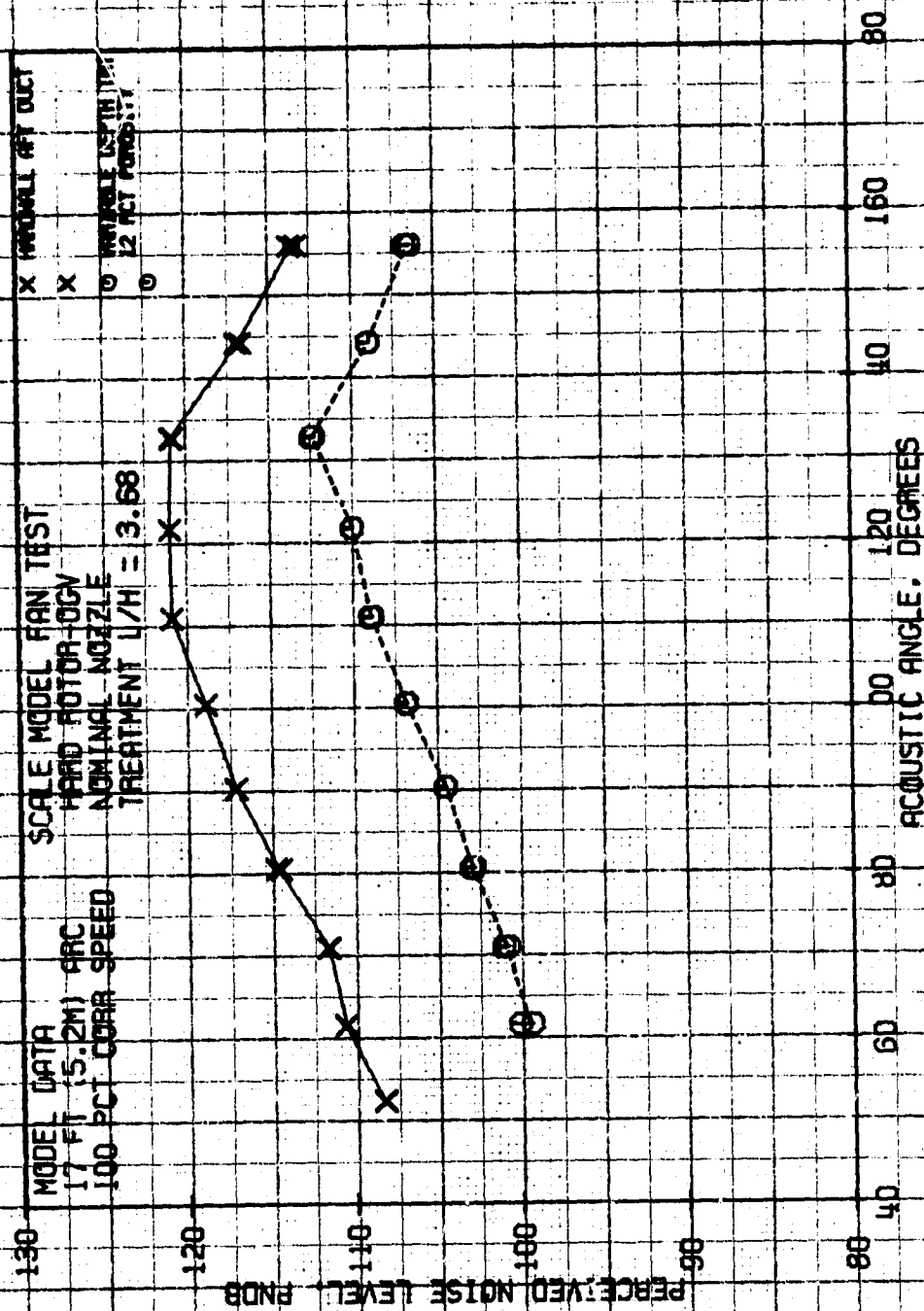


FIGURE 297



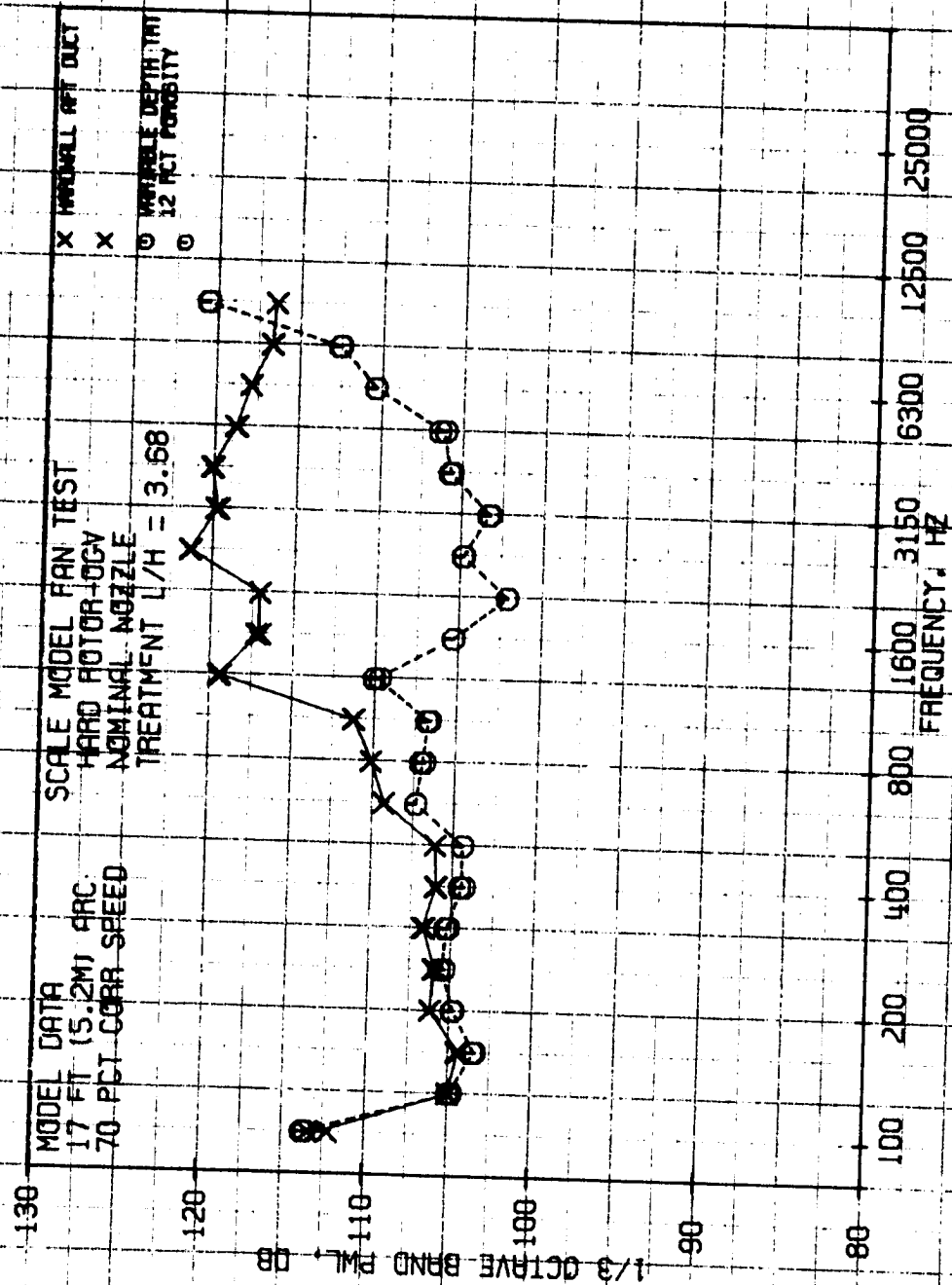


FIGURE 298

75-9

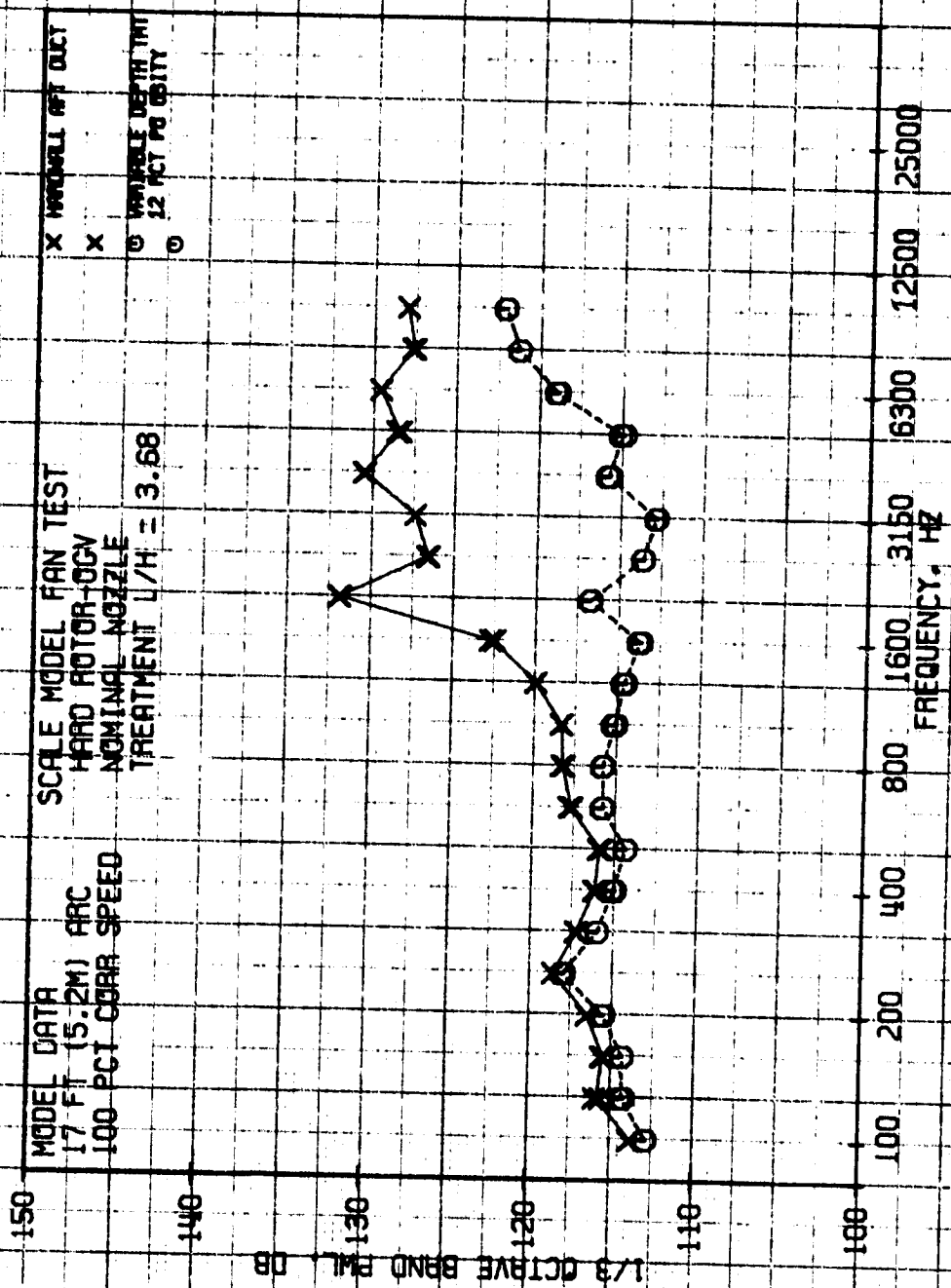


FIGURE 299

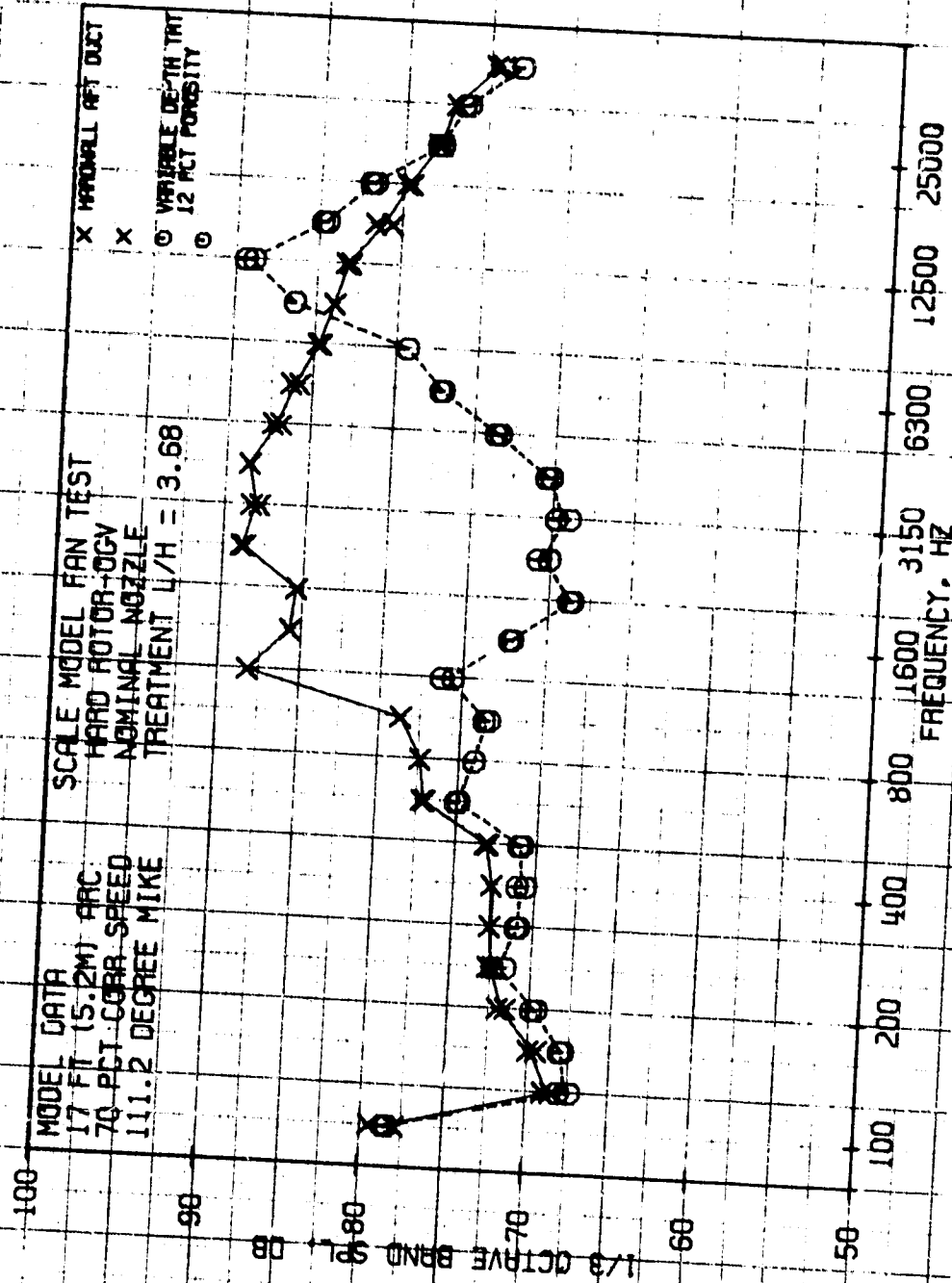


FIGURE 300

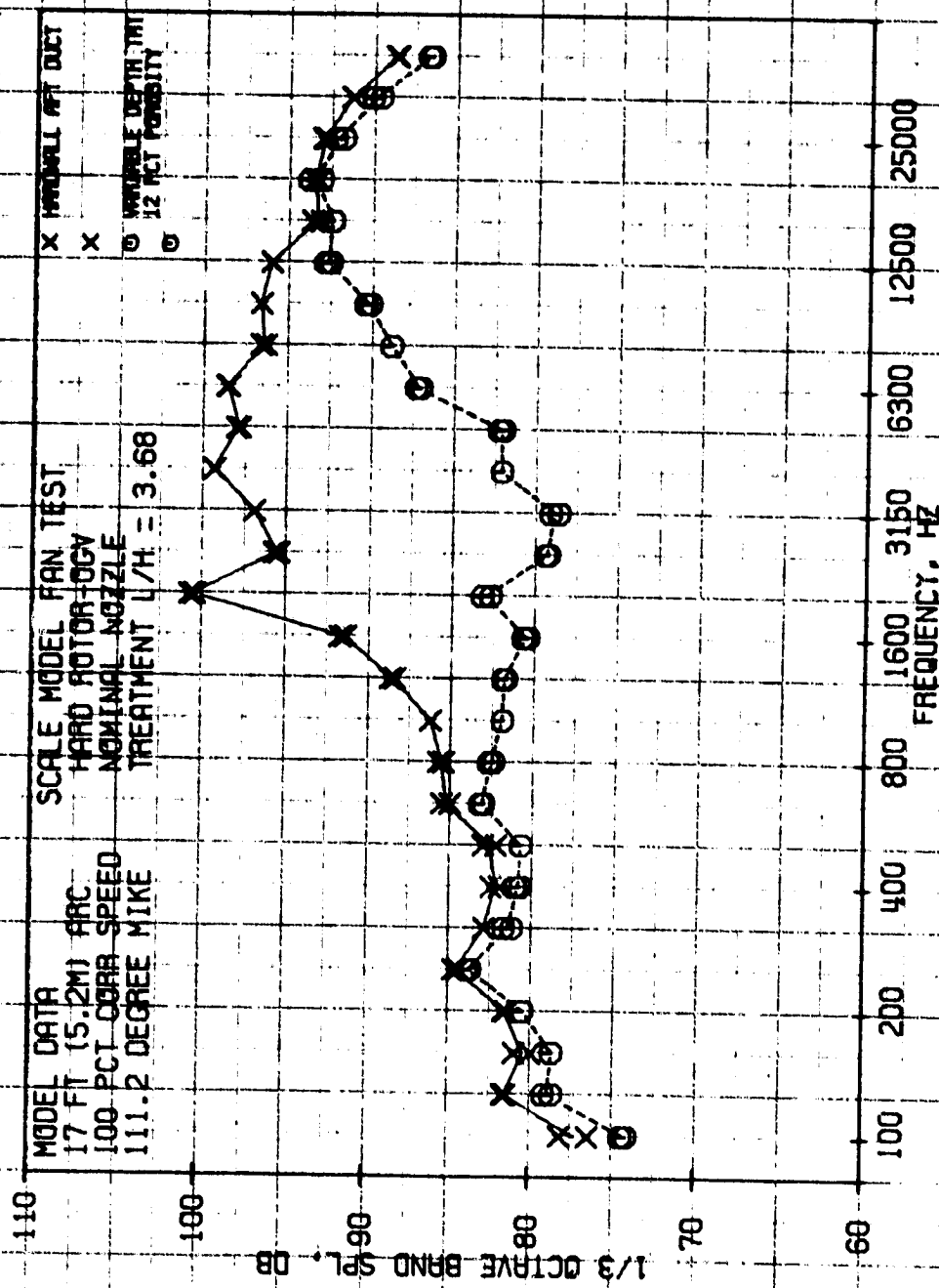


FIGURE 301

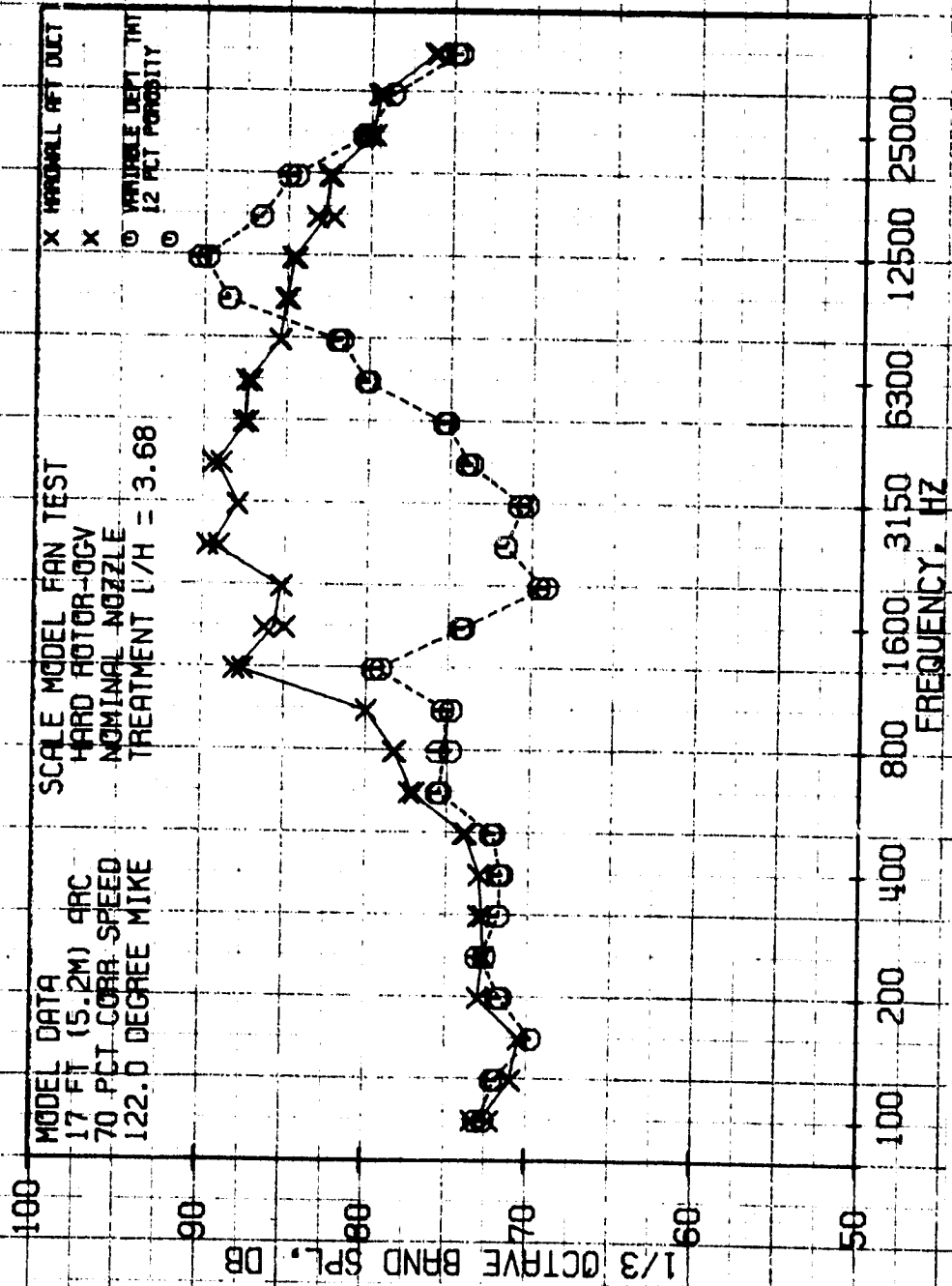


FIGURE 302

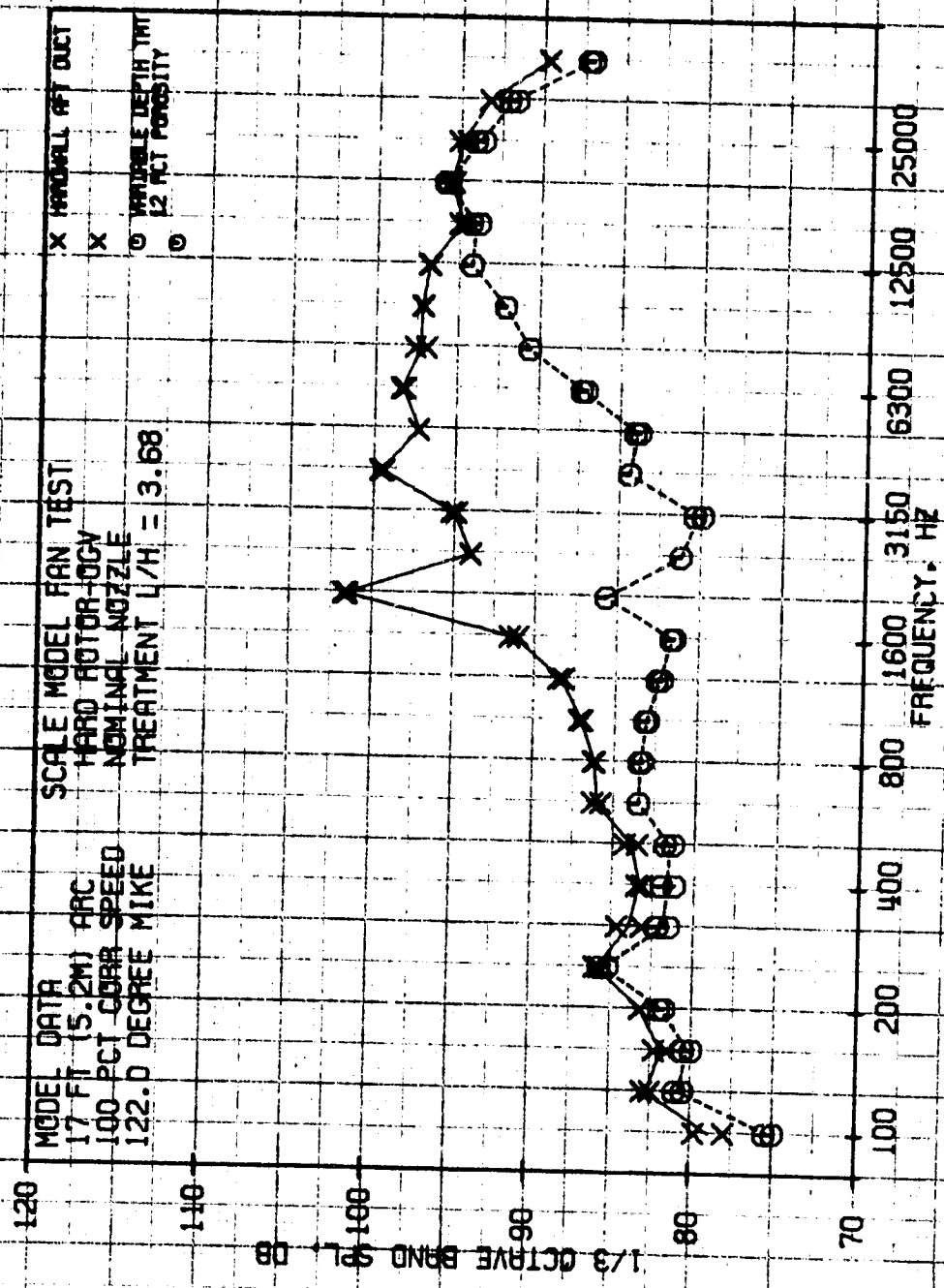


FIGURE 303